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## THE CONVENTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The annual convention of the American Institute of Electrical Engineers, which was held in Boston, Mass., last week, has added another to the long list of notable gatherings which have registered the successful outcome of careful preparation by the committees having the arrangements in charge. The Boston convention will go down in history as one of the most successful which has yet been held. Barring the weather and the crowded program, conditions were ideal. Great credit is due the Local Convention Committee and especially the Entertainment Committee for the careful and complete preparations which were made for the convenience and pleasure of the members and guests. Attendance at the convention, amounting to 934, was one of the highest yet recorded, though not quite equal to the registration at Chicago last year.

There were 55 papers presented at the various sessions of the convention, nine in number, which made an average of more than six papers to the session, whose average length was about two and one-half hours. As the papers were not evenly distributed, however, certain of the sessions were very congested, 33 of the papers being presented upon the last day, when parallel sessions were held morning and afternoon. The result was that justice could not be done to many of these papers. In general it was only possible to present papers in abstract and frequently the discussion had to be cut off because the time was so limited. Many protests arose at this condition of affairs, which one of the chairmen designated as "frenzied engineering." To make the matter worse, a large portion of the papers were not available in print until the opening day of the convention, so that it was not possible for those interested to read and digest the contents prior to the convention. There can be no question that these conditions militated against getting the most good out of many of the papers, notably those at the sessions for power station and industrial power. It does not help matters any to place blame for this condition, and indeed it would be hard to do so. Many of the authors were late with their manuscripts and this necessarily held back the publication of the June *Proceedings,* which included those papers which had been prepared well in advance. Past experience seems to have taught little in correcting this condition, and what was said in these pages one year ago, regarding the Chicago convention, may well be repeated in this connection:

"The program at the convention was decidedly over-

crowded and an improvement in this feature seems both possible and very desirable for future conventions. The number of papers presented was entirely too great, and, considering their general mediocrity, almost inexcusable. A large number of the papers presented could have been omitted without detracting from the success of the convention. It was apparent at most of the sessions that there was insufficient time for the proper presentation of the papers, and in many cases discussion had to be limited, notwithstanding the length of the sessions. The great disadvantage of an incomplete presentation of a paper is emphasized when, as at the present convention, a large number of the papers were not printed sufficiently in advance to permit of their reading by the members before starting for the convention. This, be it understood, is not due to any delay in the secretary's office, where some admirable work was done this year in rushing papers into print, but the trouble lies in the late receipt of the papers at that office. An obvious remedy for this condition, especially when there is an abundance of papers, lies in excluding from the program every paper which is not submitted in ample time."

An excellent procedure which might have been followed this year would have been to defer the reading of all papers which were handed in late until next year's convention. This would have insured early printing of this year's papers, with a program of sufficient length and value for one convention, and would have provided a stock of material for next year, which would have prevented the usual scramble at that time by the committee to secure papers and by authors in their preparation. The attempt, which was evidently made by this year's committee, to cover a large range of subjects, can hardly be considered desirable, as it would be preferable to feature different divisions of electrical engineering at different conventions and concentrate attention in somewhat narrower lines.

Having now held two successive conventions in large cities, it might be well for the next convention to select some summer resort, as has been done in several previous years. The Frontenac and Jefferson conventions demonstrated the effectiveness of such an arrangement in holding the members together during the convention, but they suffered somewhat in attendance on account of their inaccessibility. If a resort of this nature were selected in some more central location it might be possible to obtain the advantages of an isolated resort without sacrificing the attendance. A central location, such as the mountains of Western Pennsylvania or Virginia, or one of the lake resorts of the Middle West, would seem to meet the necessary requirements, and it is recommended that next year's committee give earnest consideration to these possibilities.

The masterly way in which President Dunn occupied the chair during the meeting and acted as toastmaster at the banquet, was much commented upon and brought forth a vote of appreciation from the meeting. In addition to this the delegates were moved to propose a more material form of testimonial to be granted in the future to the past-presidents of the Institute. The administration of President Dunn has indeed been marked by great devotion upon his part to the duties of the office, and the very successful holding of the numerous meetings which have been held in various parts of the country. His conduct of the office has set a standard which will require a determined effort on the part of his successors to meet. The reception given to the address by President-elect Mershon indicated fully that the membership of the Institute wishes him an equally successful administration and are ready to fully co-operate in helping him to attain it.

## THE INCREASING PRECISION OF COMMERCIAL MEASUREMENTS.

One of the most significant phases of recent electrical progress is the advancement which is being made in the field of commercial measurements. The contrast between the apparatus available but a few years ago and the instruments on the market today is both surprising and gratifying. It was inevitable that the extension of electrical service into every branch of industry should lead to improvements in the methods of measuring energy, for the actual money value of accuracy of indication and record is of much greater importance than is sometimes realized. A difference of one-tenth of an inch in reading a curve-drawing meter may correspond to a discrepancy of several thousand dollars a year in the adjustment of bills for the sale of energy on a large scale. The standards of former days are often unequal to the demands of present practice, and it is an auspicious sign that so much attention is being given, not only to the production of instruments capable of measuring electrical quantities with a greater range and with far closer accuracy than before, but that the sources of error in auxiliary apparatus are being studied with so much insight.

The papers read before the Electrical Measurements sessions at the Boston convention illustrate this point in a striking degree. They show how specialized the electrical industry is becoming, but apart from this, they emphasize a great gain in efficiency for the art as a whole, since by means of the equipment and methods now available, the sources of loss and error in distribution circuits, switchboard apparatus, current transformers and lines are being detected and analyzed with profound skill. In the tubular dynamometer described by Dr. P. G. Agnew, for example, for the accurate measurement of heavy currents, a current as high as 5,000 amperes may be checked with an accuracy of one-twentieth of one per cent, and even the slight preliminary error noted at a frequency of 300 cycles has been eliminated by mechanical improvements determined by a purely electrical test of axial symmetry. The multiplication of the capacity of the instruments over four-fold by the simple expedient of water cooling illustrates the value of mechanical co-operative methods in increasing the

range of delicate measurements of commercial value.

Again, the use of the Wheatstone-bridge—rotating-standard method of measuring large and rapidly fluctuating currents along the lines worked out by Professor H. A. Laws and Messrs. Ingalls and Cowles of Boston, marks a distinct advance which is of great value in such work as the measurement of energy sold by central stations to electric-railway systems, whose feeder circuits are supplied with direct current from substations of the lighting organization. The use of a differential galvanometer with a standard of moderate capacity permits accurate measurements to be made without sacrifice of a high degree of portability, and gives much better results than the common method of the indicating instrument and stop watch, which is best adapted to the measurement of steady loads. In the alternating-current field, the growing use of induction instruments is literally developing a new field of service in which with compactness of installation, is obtained a high degree of accuracy, high ratio of torque to weight, simplicity of structure and negligible external-field errors.

In the important field of current-transformer design, advanced methods of studying the phase angle and ratio are evidenced by the latest publications read at Boston, and a sensitivity of 1 in 10,000 at one-tenth load is now possible in apparatus of this type, when using a detector sensitive to about 2 microvolts. Improved methods of testing such transformers, in which but a single observer is required, without a polyphase source of voltage, phase-shifting device or rotating commutator, all point to the steady advance of the art of accurate measurement and to the progress of research into phenomena heretofore hidden or at least difficult of access. In the light of the Boston papers and discussions, the reputation of alternating-current instrumental work is certain to advance still further from the more or less doubtful status which it bore a few years ago.

## WIRELESS TRANSMISSION.

Ever since the celebrated experiments of Heinrich Hertz, the possibility of radiating electric energy from an oscillator to a receiving apparatus was realized. At first it seemed as if the feebleness of such radiation would prevent its transmission to any considerable distance, but the persistent work of Marconi and other investigators showed that transmission to a considerable distance is quite possible by this method. With the further developments of the art it was found, however, that the practical results in wireless transmission did not entirely agree with the laws which were theoretically derived on the basis of the Hertz-wave theory.

Another phenomenon which has puzzled experimenters and practical operators in wireless telegraphy is the fact that the distance of transmission of wireless signals, which of course depends upon the rate of attenuation, depends upon atmospheric conditions and most notably upon the time of day; that is to say, whether the portion of the earth over which the signals are being transmitted is experiencing day or night.

There has been an attempt to connect the latter phenomenon with the state of ionization of the atmosphere, which is naturally assumed to be different when the sun is shining upon it than at night time. The ionization effect of ultra-violet light is well known and the radiation of the sun is known to contain a considerable proportion of these important wave-lengths. There has been no satisfactory relation established, however, between the conditions of ionization and the strength of the received signals.

In an article which will be found upon pages 34 and 35 of this issue, Dr. Nikola Tesla has propounded a theory, which is supported by his experimental observations, to account for the practical results which have been observed. He has come to the conclusion that the Hertzian waves are responsible for but a small part of the energy which is transmitted from a wireless antenna, the main consideration in such transmission being conduction through the earth. Of course it is not maintained that signals cannot be and are not transmitted by Hertzian waves, as in some cases, notably in transmission to and from balloons and aeroplanes, earth currents are eliminated and dependence must be placed entirely upon radiation through the atmosphere. In most cases of long-distance signaling, however, earth connections are found essential to the best results and it cannot be doubted that the currents flowing into and out of the earth at the point of connection of the antenna or the auxiliary apparatus are important incidents in the operation.

Regarding the effect of sunlight upon transmission, Dr. Tesla presents a unique explanation which experts in this field would probably not be willing to accept without further demonstration. He attributes the change in facility of transmission to the evaporation of moisture from the earth's surface in places which are exposed to the sun's rays. Of course such evaporation is increased by the heat absorbed from the sun's radiation, a phenomenon which affects the conditions in the superficial layer of the earth's crust. Conduction through the earth could itself scarcely be effected in this way, but the explanation given by Dr. Tesla is that the evaporated particles of moisture carry off with them an electrical charge which affects the electrical distribution on the earth. He states that the dissipation of energy is proportional to the cube of the frequency, which would indicate that the best condition for transmission would be a low frequency and consequently large wave-length.

Dr. Tesla promises at some future time to contribute a more extensive discussion of this subject, disclosing the lengthy investigations which have led him to these important conclusions. The scientific and technical world will eagerly await a fuller demonstration of the truth of this theory.

## Annual Meeting of National Electrical Credit Association.

The thirteenth annual meeting of the National Electrical Credit Association was held at Hotel Hollenden, Cleveland, O., on June 26, and was probably the most successful and enjoyable meeting which the National Association has held—at least, for some years. There were representatives in attendance from the five local associations of Boston, New York, Philadelphia, Chicago, and San Francisco, and the attendance generally was larger than at any previous meeting in the last ten years.

The reports for the year showed increased activities on the part of members, with correspondingly greater benefits returned to each, all of which aroused the enthusiasm of the members present.

The annual election resulted as follows:

President, George J. Murphy, of Pettingell-Andrews Company, Boston, Mass.

Vice-President, John H. Dale, of The Dale Company, New York City.

Secretary-Treasurer, Frederic P. Vose, Chicago.

This is the thirteenth consecutive reappointment which Mr. Vose has received at the hands of the National Board of Managers, having served as general secretary of the organization from its inception in 1898.

An Entertainment Committee, of which H. E. Hackenberg, of the National Carbon Company, Cleveland, was chairman, provided a luncheon for the visiting delegates, which was served at the Hollenden, and in the late afternoon an automobile ride through the business sections and parks of Cleveland was enjoyed, followed by a dinner at the new Cleveland Athletic Club. After the dinner, C. T. McKinstry, of the Erner Electric Company, acted as toastmaster, and the large company present listened to inspiring talks on the service and accomplishments of the Electrical Credit Association and the substantial benefits which had accrued to the trade as a result of nearly five hundred representative manufacturers and jobbers co-operating in the exchange of their ledger experiences for the credit guidance of their fellow members.

## Venezuela Adopts Metric System.

Venezuela has adopted the metric as the official system of weights and measures, and has made its use obligatory in courts and other public offices. An exception is made in the case of documents originating in a foreign country, where the money, weight, or measure of the country of origin may be expressed.

## Special Train to New River Hydroelectric Developments.

General Manager H. W. Fuller of the Appalachian Power Company, Bluefield, W. Va., was host to more than 100 mine operators and others interested in the large application of power, Wednesday, June 19, on a trip to developments Nos. 2 and 4 of the company on the New River.

Mr. Fuller and other representatives of the company lent their every effort to making the trip enjoyable. A special train was engaged leaving Bluefield early in the morning and returning in the evening. Guests outside of Bluefield were picked up en route to the dam sites. Individual menu cards bearing the Appalachian Power Company monogram were used for breakfast and luncheon.

The dinner menu was in the form of a folder, the outside cover being black, setting off in contrast the white outline of the large sign of the Appalachian Power Company recently erected on the hill overlooking Bluefield. Sketched through the menu inside were the outlines of a high-tension transmission line.

Representatives of the company personally conducted the party over the developments.

It was announced that development No. 4 will be ready to furnish power August 1 and development No. 2 October 1, the former will have a capacity of 13,000 kilowatts and the latter 16,000 kilowatts.

A 36-page booklet giving the history of the company and containing photographs and statistics showing the progress of the work to date was given each guest as a souvenir.

Besides Mr. Fuller the following representatives of the company were in the party: H. W. Buck, M. A. Viele, L. G. Gresham, B. W. Lynch, D. M. Bunn, A. Felio and H. E. Shed.

## Dering Library Presented to Massachusetts Institute.

The most complete collection of books on electricity is said to be comprised in the library of the late George E. Dering, of England, who died last year. This library comprises 18,000 books and 9,000 pamphlets, besides reports and periodicals. About three-fifths of these treat of electrical subjects. This library has been presented to the Massachusetts Institute of Technology by Theodore N. Vail, and accompanying the gift is an endowment for its maintenance.

Mr. Dering made this library his chief hobby and occupied 40 years in collecting the volumes. He gave a standing order to a London bookseller for all books in every language that pertained to electrical engineering.

## Program for Ohio Electric Light Association.

Final preparations are being made for the eighteenth annual convention of the Ohio Electric Light Association, which will be held at Cedar Point, O., on July 16, 17, 18 and 19, 1912. The officers expect that all previous conventions of the Association will be excelled by that of 1912 in point of program, attendance, exhibits and entertainment.

Among the papers to be presented are the following: Address of President; Report of Committee on Electrical Transmission; "Rate Making," by Halford Erickson, chairman Railroad Commission of Wisconsin; "The Public vs. the Utility," by D. L. Gaskill; Report of the Committee on Costs; Report of the Committee on Motors; "Electrolytic Purification of Sewerage," by F. C. Caldwell; "Supplying of Electric Energy to Rural Districts," by J. C. Matthieu; "Joint Pole-Line Construction," by J. L. Spore.

Elaborate arrangements are being made for the entertainment of delegates and guests, and Secretary D. L. Gaskill, of Greenville, O., advises that all those desiring to attend should make reservations at once to the Breakers Hotel at Cedar Point.

## Announcement Concerning Flexible Cords.

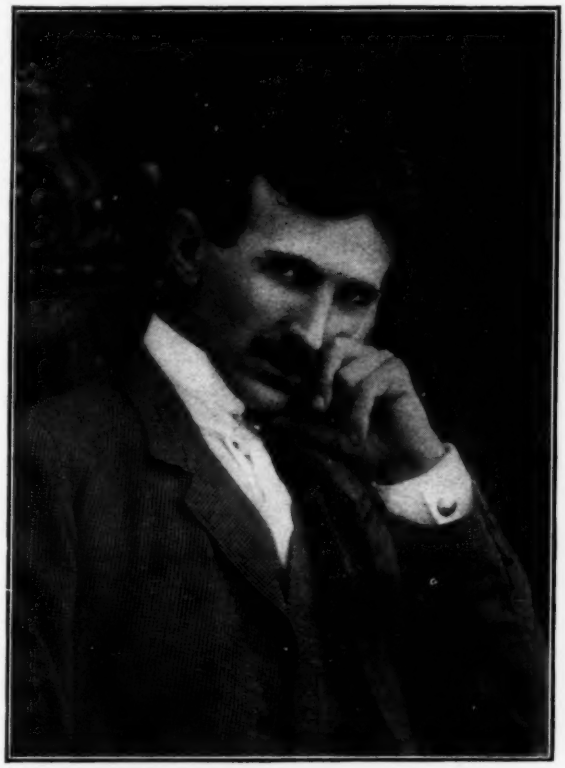
An announcement has been issued by the Underwriters' Laboratories stating that the inspection of flexible cords made and approved under the old specifications was discontinued on April 1, 1912. Flexible cords are now available which are made and approved according to the specifications of the 1911 edition of the National Electrical Code. Cords which have been examined at the factories and approved by the Underwriters' Laboratories may be recognized by the labels attached to coils. These standard labels are illustrated on page 105 of the April (1912) edition of the List of Electrical Fittings. This list, and also the lists of April and October, 1911, advises against the use after July 1, 1912, of flexible cords made under the specifications found in the 1909 edition of the Code. However, in view of the fact the inspection and labeling of cord under the specifications of the 1909 Code was not discontinued until April of the present year, the Underwriters' Laboratories recommend that the installation of old-Code cords be allowed up to October 1, 1912, instead of being discontinued July 1, as was previously contemplated. This will afford the usual six months' interval for the disposition of manufactured stocks.

## Nikola Tesla.

In the realm of electricity and physics few men have striven for such mighty achievements and attained such prominence through the working out of ideas greatly in advance of current thought as has Nikola Tesla, the subject of this sketch.

Nikola Tesla was born at Smiljan, Lika, the border country of Austria-Hungary, in 1857, the son of a Greek clergyman and orator, and Georgina Mandic, who was an inventor, as was her father. Tesla was educated for a year in the elementary schools, for four years at the lower Realschule, Gospic, Lika, and for three years at the higher Realschule, Carlstadt, Croatia, graduating in 1873. He was a student for four years at Polytechnic School, Gratz, in mathematics, physics and mechanics. After this he studied two years in philosophic studies at the University of Prague, Bohemia. He has received the honorary degree of Master of Arts, from Yale, in 1904, and Columbia, N. Y., conferred the degree of LL.D. in 1894.

Nikola Tesla began his practical career at Budapest, Hungary, in 1881, where he made his first electrical invention, a telephone "repeater," and conceived the idea of his rotating magnetic field. He later engaged in various branches of engineering and manufacture, and, since 1884, has been a resident of the United States, becoming a naturalized citizen. Dr. Tesla is the author of numerous scientific papers and addresses, and his inventions and discoveries cover a wide range. Speaking chronologically, his chief work may be summed up as follows: systems of arc lighting, 1886; Tesla motor and system of alternating-current power transmission, 1888; system of electrical conversion and distribution by oscillating discharges, 1889; generation of high-frequency currents and effects of these, 1890; transmission of energy through a single wire without return, 1891; Tesla coil or transformer, 1891; investigations of high-frequency effects and phenomena, 1891-1893; system of wireless transmission of intelligence, 1893; mechanical oscillators and generators of electrical oscillations, 1894-1895; researches and discoveries in radiations, material streams, and emanations, 1896-1898; high-potential magnifying transmitter, 1897; system of transmission of power without wires, 1897-1905; economic transmission of energy by refrigeration, 1898; art of "Telautomatics," 1898-1899; burning of atmospheric nitrogen and production of other electrical effects of transcending intensities, 1899-1900; method and apparatus for magnifying feeble effects, 1901-1902; art of individualization, 1902-1903. Since 1903, Dr. Tesla has been chiefly engaged in the development of his system of world telephony and telegraphy, and the design of a large plant for the transmission of power without wires. He has also devoted a great deal of energy to the development of a perfected system for the electrical production of nitrates from the atmosphere and quite recently announced the development of a remarkable form of turbine, the perfecting of which when realized will mean practically a revolution in our application of mechanical principles. In the current issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN Dr. Tesla discusses with characteristic candor and vigor some new ideas with regard to the propagation of electrical impulses through the air without wires.



**Nikola Tesla,**
Noted Electrical Inventor and Scientist.

## Water-Power Developments in Tennessee.

The Tennessee Eastern Electric Company is a new entrant in the hydro-electric field of Eastern Tennessee, following the Tennesese Power Company, which is developing water-power projects on the Ocoee River and Caney Fork, and the Tennessee Hydro-Electric Company, which is making use of the power possibilities of the Clinch and Powell Rivers. The Tennessee Eastern Electric Company has selected the Nolachucky River as the stream it is to develop, and will build a $500,000 plant six miles from Greeneville, Tenn. It has taken over the Greeneville Electric Company, and will use the plant there as a substation when the new plant is completed. It has also purchased control of the Watauga Power Company and the Johnson City Traction Company, both of Johnson City, Tenn. It is reported that $500,000 was involved in this deal. The company has applied for franchises in Erwin, Jonesboro and Morristown, and plans not only to distribute electrical energy to those communities and others in the same section, but may also build an interurban traction system connecting the leading communities of Eastern Tennessee. The design and construction of the Nolachucky plant will be in charge of W. V. N. Powelson, of New York, former president and general manager of the Union Electric Light & Power Company, of St. Louis, who until recently has been consulting engineer with headquarters in New York. He will make his offices at Johnson City as soon as plans for the plant are made. Amzi Smith, general manager of the Johnson City properties, will continue to have charge of them. The company plans to generate 7,500 horsepower on Nolachucky River, and hopes to be furnishing power from there by April 1, 1913. The company was organized by Warner, Tucker & Co., of Boston, and represents New England capital almost exclusively, according to statements made in financial circles.

## Officers of New England Section, Illuminating Engineering Society.

The following officers of the New England Section of the Illuminating Engineering Society have been elected for the coming year: chairman, R. B. Hussey; secretary, H. C. Jones; managers, H. C. Clifford, C. A. B. Halvorson, J. M. Riley, R. C. Ware, W. E. Wickenden. The address of the secretary is 10 High Street, Boston, Mass. Meetings are held in Boston.

## Progress in the Development on New River.

The Appalachian Power Company was organized in May, 1911, for the purpose of developing the water power of the New River in Southwestern Virginia. The company acquired five separate power sites in Carroll and Pulaski counties aggregating 75,000 horsepower. Two of these sites are now in process of development and will together give 29,000 horsepower.

The Appalachian Power Company has acquired the electric lighting, railway and power systems in the towns of Marion, Wytheville, Pulaski, Bluefield, Pocohontas, Welch and Keystone, all of which are within 50 miles of the water-power sites. They will all be fed with power from these developments. High-tension transmission lines are being built to the Pocohontas coal fields, to Bluefield and to Roanoke, and later similar lines will be constructed to Martinsville, Danville and Saltville. These lines will operate at 88,000 volts. Contracts for delivery of power have already been secured from a number of the coal mines and other operators in this vicinity.

The company has published an attractive bulletin showing progress on the construction of the plant up to May 22. The company is under the management of H. M. Byllesby & Company. The consulting engineers in charge of construction are Viele, Blackwell & Buck.

## Electrical Exports for May.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has completed its monthly summary of the imports and exports of the United States for May. From this source the following data have been obtained.

The figures as to electrical-appliance exports for May establish a new and remarkable record, the total exceeding by nearly 16 per cent the previous high mark set last December. This was largely due to exceptionally heavy shipments to Brazil. The machinery exports also showed improvement over those of a year ago, but were less than the preceding month. A comparative monthly statement follows:

| Month. | Electrical Appliances. | Electrical Machinery. | Total. |
|---|---|---|---|
| May, 1912... | $1,349,800 | $718,546 | $2,068,346 |
| May, 1911... | 987,264 | 627,840 | 1,615,104 |
| April, 1912.. | 923,631 | 820,385 | 1,744,016 |

A list of the principal countries to which electrical shipments were made last May, together with the value of these exports, is given below:

| Countries. | Electrical Appliances. | Electrical Machinery. |
|---|---|---|
| United Kingdom..... | $86,636 | $98,006 |
| Canada ..... | 365,143 | 182,580 |
| Mexico ..... | 90,443 | 60,652 |
| Cuba ..... | 98,178 | 16,066 |
| Brazil ..... | 415,327 | 58,652 |
| Japan ..... | 53,435 | 92,920 |

## Changes in Electric Construction and Inspection Requirements in New York City.

The Bureau of Electrical Inspection of the City of New York has issued an announcement that on July 1 the approval of old-Code fixture wire was discontinued within the jurisdiction of that department. Fixture wire made and approved under the specifications of the 1911 edition of the National Electrical Code will hereafter be required in all installations, except those for which applications for inspection were made prior to July 1.

On and after October 1, 1912, new-Code rubber insulation will be required on all installations of flexible cord, armored flexible cord, reinforced flexible cord, Canvasite and Crefield flexible cord, special stage cables, battery-charging cables, etc., for which applications for inspections are not on record prior to that date.

Rule 12*g* fourth paragraph, of the city electrical code has been amended to permit twin-conductor lamp lead to be carried down combination poles on insulators. Twin-conductor wire, with insulation specially approved for the location, may be run vertically on pins or brackets down the pole and drawn taut and fastened upon standard insulators. This wire must be firmly held at a distance of not less than five inches from the surface of the pole.

On August 1, 1912, a working agreement with the Suburban Fire Insurance Exchange, similar to the working agreement now in existence between the Department and the New York Board of Fire Underwriters, will be placed in effect. George E. Bruen, superintendent of the electrical department of the Exchange, will become a member of the Advisory Board of Engineers. The present method of endorsing Underwriters' certificates will be applied to the entire city, the portion covered by the Suburban Fire Insurance Exchange being that portion of the Bronx east of the Bronx River, all of Richmond, and all of Queens except Long Island City.

On and after June 1, 1913, the introduction of wooden molding for electrical purposes in New York City will be prohibited.

## Electric Club Smoker.

On the evening of June 27, the Electric Club of Chicago tendered to its members a complimentary vaudeville and smoker, the occasion marking the inauguration of the annual summer vacation period of the club. It was held in the Louis XIV room of the Hotel Sherman and was pronounced the most successful function ever conducted by the local organization.

The entertainment opened with a seven-act vaudeville bill, professional talent being engaged. This was followed by several wrestling bouts, including one by Japanese. A buffet supper was served after the close of the entertainment.

John Harmon and H. G. Hafner, assisted by the officers of the club and the entertainment committee, arranged all details and are deserving of great credit for the manner in which the affair was conducted.

## Production of Coal in the Rocky Mountain States.

The complete returns of the coal production in the states of the Rocky Mountain region in 1911 have been received by the United States Geological Survey. The eight states included, namely, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Utah and Wyoming, produced in 1911 a total of 26,044,387 short tons, valued at $40,098,747. Although no coal was produced in Nevada in 1910, the output of the seven other states was 28,857,413 short tons, valued at $43,776,715, indicating a decrease in 1911 of 2,813,026 short tons, or 9.7 per cent in quantity, and of $3,677,968, or 8.4 per cent in value. This decrease was due to the resumption of mining in the Mississippi Valley States, the idleness in which, caused by the strike in 1910, resulted in extraordinary demand on the mines of most of the Rocky Mountain States.

In Montana and North Dakota the production in 1911 exceeded that of 1910, in the former by 55,388 short tons and in the latter (which produced lignite exclusively) by 103,587 short tons.

In importance of production Colorado ranked first in 1911 with an output of 10,157,383 short tons; Wyoming second, with 6,744,864 short tons; and New Mexico third, with 3,148,158 short tons.

Coke is made in Colorado, New Mexico and Utah. Colorado's coal made into coke in 1911 amounted to 1,424,251 short tons, or 14 per cent of the total output of the state. New Mexico consumed 767,108 short tons, or 25 per cent of the total production of the state, in the manufacture of coke, and Utah 381,696 short tons, or 15 per cent of the total output. The total quantity of coal consumed in the manufacture of coke at the mines of the Rocky Mountain States was 2,573,955 short tons,

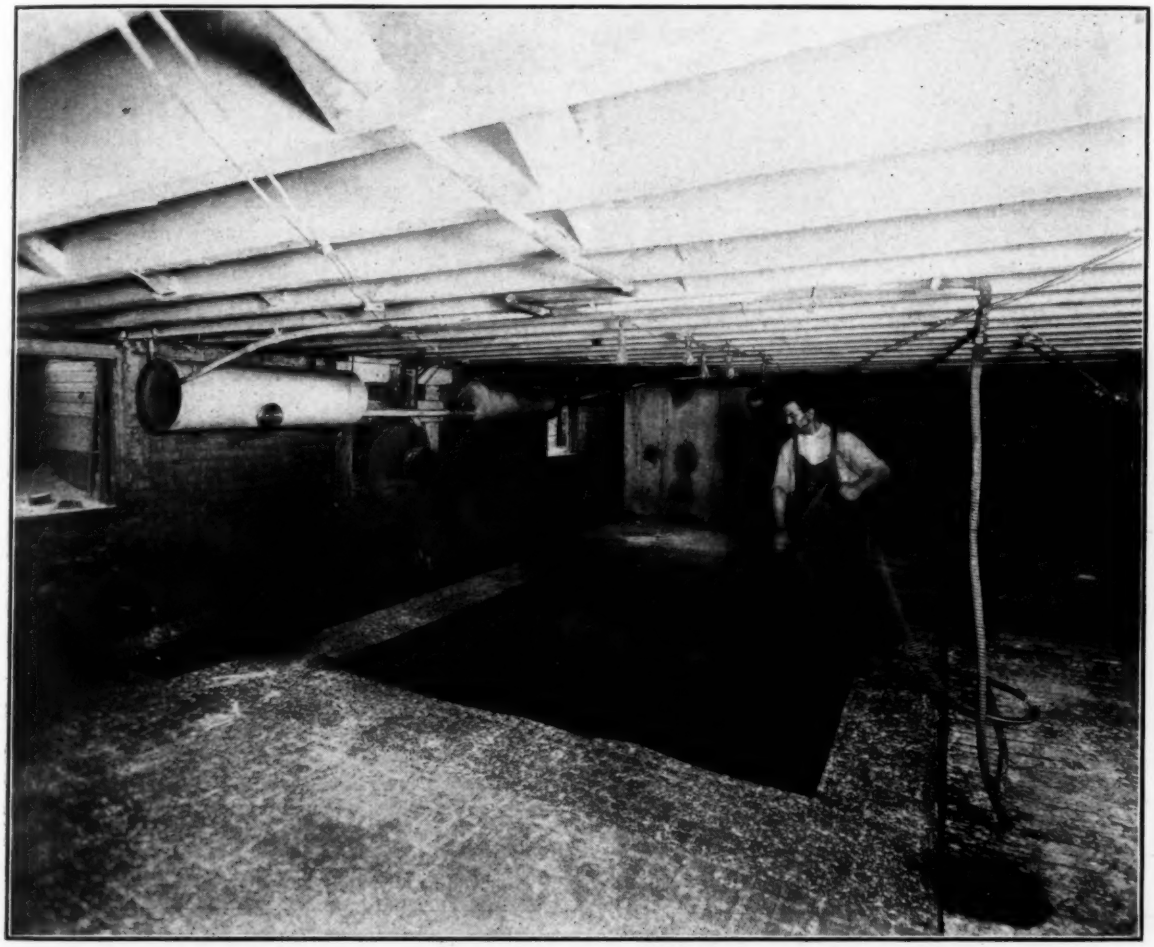
It is stated that an American correspondent of a London newspaper cabled more than 77,000 words from America to his paper concerning the loss of the *Titanic*.

# Electric Drive for Carpet Cleaning.

Every town of sufficient activity to have central-station electric power service will probably also have one carpet cleaning establishment, if not several.

Equally is it true, that the peculiar conditions surrounding this business make it especially the legitimate field for central-station power.

There are two short seasons in the Spring and Fall when carpet cleaners are so busy that overtime work is the expected thing. From this peak of the business, there is a gradual falling off to almost none, after which the rise again occurs. The natural result is a combination of carpet cleaning with some other allied business, usually storage of household effects or rug and carpet weaving. The latter supplies an opportunity for further power business with the central station. A case of this kind is described below.



Cleaning Room in Chicago Plant.

The equipment consists of two tumbler wheels, 12 feet diameter, 8 feet wide; two 36-inch exhaust fans; one tumbler wheel, 14 feet diameter, 10 feet wide; one 42-inch exhaust fan; one 2,000-pound elevator; one air compressor, 50 pounds; one carpet beater; one 48-inch exhaust fan; two 9-foot looms for weaving rugs; three sewing machines; and one winder.

The two tumblers with their 36-inch fans are driven by a 15-horsepower motor, running at 850 revolutions per minute. The large tumbler and its fan were at first driven by a 10-horsepower motor. Later on this tumbler was mounted on roller bearings and a 7.5-horsepower motor substituted. It was found to be just a good load for this motor.

A three-horsepower motor takes care of the elevator, belt driven, through a counter shaft, with straight and crossed belts to the elevator drum. This elevator carries 2,000 pounds and travels 18 feet in 24 seconds.

The carpet beater, a special machine, together with the 48-inch exhaust fan, is driven by a 7.5-horsepower motor, running at 850 revolutions per minute.

Another 7.5-horsepower motor operates the weaving department and the air compressor. The latter is used very little.

All of the motors are two phase, squirrel-cage type operating at 60 cycles, 220 volts.

On account of the loading and unloading of the drums, a full day's work would not see them in operation more than two-thirds of the time. Twenty to thirty minutes is required to unload and refill them. The carpets are then tumbled for about 45 minutes. The maximum load is 250 yards of carpet weighing about 800 pounds; 600 pounds is about an average, for the smaller wheels. The large wheel will take 25 per cent more.

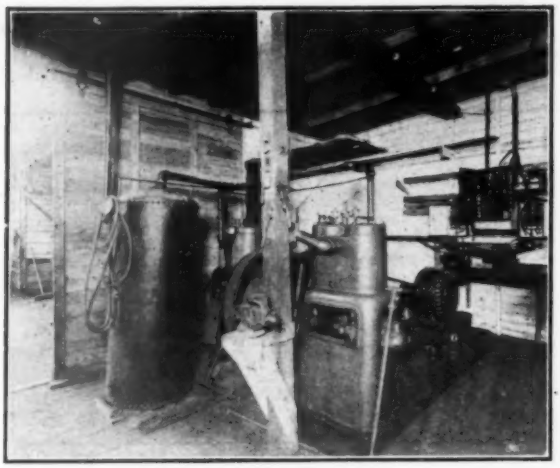
The fans always operate with the wheels to suck away the dust. The motors are belt connected to counter shafts and the drums started with fric-

tion clutches. Experience shows that two wheels driven together operate to much better advantage than one alone. The work on the motor is very variable. As the carpet rises on one side, with the wheel in turning, the maximum pull is experienced; then as it reaches the top and falls, the load is momentarily, friction only. The carpet falls with a thump and again starts on its upward climb. This condition is much more noticeable when the wheel is lightly loaded, but they can not be loaded too full for the carpets will then be not well cleaned. When two are operated together the moments of fall and rise are not likely to occur at the same instant and one tends to balance the other relieving the jerking on the motor.

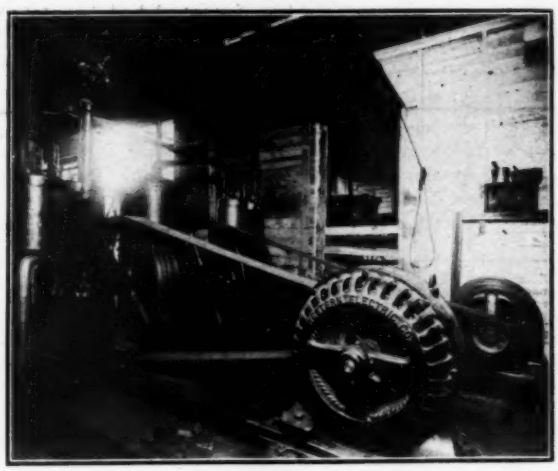
The carpet beater consists of a revolving cylinder or roll 16 feet long carrying flexible beaters which strike the carpet a series of hard blows, while the suction from the exhaust fan constantly draws away the dust. The carpet or rug is automatically fed into the machine over a roller at a slow rate and the carpet is clean when it issues from the other side. The rate of feed is about 15 feet per minute.

The compressed air is used to give a final cleaning touch to the carpets as they are folded for delivery, a flexible hose and nozzle permitting the application over a large area.

All the cleaning is done on the second floor. The elevator travels only to this floor.

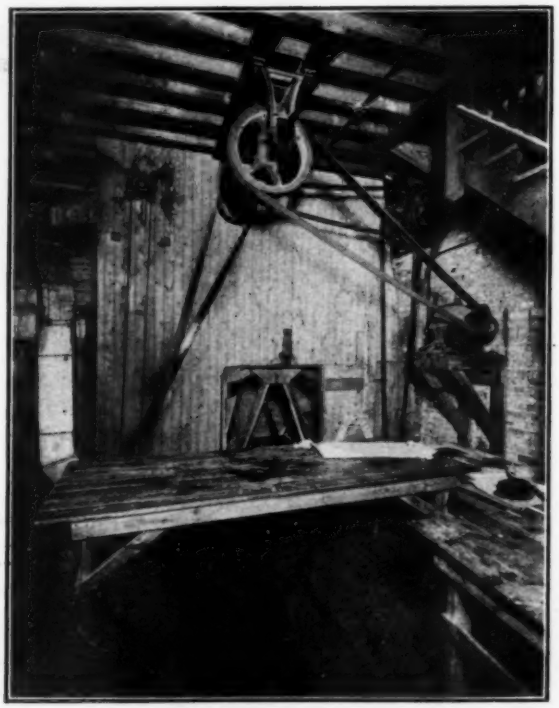


Motor Driving Compressor.



Two Motor-Driven Compressors.

Motor in Cleaning Plant.



Motor-Driven Reel.

The weaving room is operated all the year, making rugs out of old carpet. Slack periods occur during the summer so that only about eleven months' full operation are attained in this department.

Records kept over a number of years supply the following interesting data. All the power was metered together. From readings taken on days when no carpets were cleaned, it is estimated that the weaving room used one-third

## Carpet-Cleaning Data.

**The term load-factor is used in these data in such a sense that a load-factor of 100 per cent represents the use for 24 hours every day of power corresponding to the rated capacity of the motors connected. An operating-time load-factor of 100 per cent represents the use of the rated capacity of the motors for the running hours per day specified for each installation.**

Carpet-Cleaning plant, name withheld, having an average output of 2,000 yards of carpet per day, during March, April and May.

Total connected horsepower, 7.5. One motor is installed. Average kilowatt-hours per month, 185.

Kilowatt-hour consumption for 12 months:

| Month. | Kilowatt-Hours. | Month. | Kilowatt-Hours. | Month. | Kilowatt-Hours. |
|---|---|---|---|---|---|
| April | 424 | August | 58 | December | 83 |
| May | 597 | September | 96 | January | 40 |
| June | 287 | October | 163 | February | 91 |
| July | 107 | November | 194 | March | 87 |

Load-factor, 4.5 per cent.

MOTOR INSTALLATION.

The motor installed at this plant is a three-phase, 60-cycle, 220-volt squirrel-cage induction machine.

| No. | Horse-power. | Speed R. P. M. | Application. |
|---|---|---|---|
| 1 | 7.5 | 1120 | Belted through a four-foot shaft (two hangers) to a 15-foot countershaft (three hangers) driving one Thomas Ferry 12-foot diameter carpet-cleaning reel, capacity 250 yards, pulley 12 feet by 6 inches, speed 170 revolutions per minute; one Thomas Ferry 14-foot diameter carpet-cleaning reel, capacity 300 yards, pulley 14 feet by 6 inches, speed 150 revolutions per minute; and one Buffalo Forge Company 36-inch blower, speed 600 revolutions per minute. |

Ottumwa Rug Works, Ottumwa, Ia. Does a general rug-cleaning business. Combination drive. Running hours per week, 60.

Total connected horsepower, 10.5. Total number of motors installed, 3. Average kilowatt-hours per month, 445. Average kilowatt-hours per month per connected horsepower, 42.

Kilowatt-hour consumption for 12 months:

| Month. | Kilowatt-Hours. | Month. | Kilowatt-Hours. | Month. | Kilowatt-Hours. |
|---|---|---|---|---|---|
| January | 195 | May | 860 | September | 305 |
| February | 210 | June | 395 | October | 510 |
| March | 350 | July | 400 | November | 410 |
| April | 1030 | August | 430 | December | 245 |

Load-factor, 7.8 per cent; operating-time load-factor, 16.3 per cent.

MOTOR INSTALLATION.

The following is a list of motors installed with their respective drives. The supply source is 500 volts, direct current.

| No. | Horse-power. | Speed R. P. M. | Application. |
|---|---|---|---|
| 1 | 5 | 1500 | Direct-connected to an 8 by 12-foot carpet-cleaning wheel. |
| 1 | 3.5 | 1100 | Belted to a 10 by 6-inch air compressor. |
| 1 | 2 | 2000 | Belted to line shaft driving one five-inch emery wheel and one carpet raveler. |

Energy is supplied by the Ottumwa Railway & Light Company.

H. A. Smith, Pueblo, Colo. Carpet cleaner. Individual drive. Running hours per week average 60. Total connected horsepower, 20. One motor. Average kilowatt-hours per month, 1590. Average kilowatt-hours per month per connected horsepower, 79.

Kilowatt-hour consumption for 12 months:

| Month. | Kilowatt-Hours. | Month. | Kilowatt-Hours. | Month. | Kilowatt-Hours. |
|---|---|---|---|---|---|
| January | 944 | May | 3629 | September | 1521 |
| February | 828 | June | 1901 | October | 2338 |
| March | 1337 | July | 547 | November | 1876 |
| April | 2685 | August | 841 | December | 741 |

Load-factor, 14.6 per cent; operating-time load-factor, 30 per cent.

During the month of May, 1200 yards of carpet were cleaned with an average consumption of 0.303 kilowatt-hours per yard of carpet cleaned.

MOTOR INSTALLATION.

The motor is a 500-volt, direct-current, compound-wound machine.

| No. | Horse-power. | Speed R. P. M. | Application. |
|---|---|---|---|
| 1 | 20 | 900 | Belted direct to a 10 by 10-inch air compressor. This outfit is used for cleaning carpet, air being compressed to about 120 pounds pressure and carried to a receiving tank. |

Energy is supplied by the Pueblo & Suburban Traction & Light Company.

of the power metered. Using this figure in computing we get for three years:

| Year. | Yards carpet cleaned. | Kilowatt-hours. | Kilowatt-hours per 100 yards. |
|---|---|---|---|
| 1908 | 423,000 | 13,230 | 3.12 |
| 1909 | 370,997 | 11,932 | 3.21 |
| 1910 | 385,370 | 11,990 | 3.11 |

The following table showing the monthly variations, gives the total power consumed.

| | Yards carpet. | Kilowatt-hours. | Kilowatt-hours per 100 yds. | Cost per yard, cts. |
|---|---|---|---|---|
| Jan. | 6,575 | 843 | 12.8 | 0.85 |
| Feb. | 8,388 | 691 | 8.2 | 0.55 |
| March | 15,970 | 1,099 | 6.8 | 0.45 |
| April | 50,110 | 1,769 | 3.5 | 0.23 |
| May | 96,038 | 2,719 | 2.8 | 0.19 |
| June | 65,456 | 2,683 | 4.0 | 0.27 |
| July | 38,393 | 2,205 | 5.7 | 0.38 |
| Aug. | 19,671 | 1,201 | 6.1 | 0.40 |
| Sept. | 29,260 | 906 | 3.0 | 0.20 |
| Oct. | 29,469 | 1,489 | 5.0 | 0.33 |
| Nov. | 17,740 | 1,351 | 7.6 | 0.50 |
| Dec. | 8,300 | 1,029 | 12.4 | 0.82 |

These figures are somewhat misleading because, as stated, all power is included. If these costs are taken as shown, then the power for the weaving room cost nothing and the profit for that department should be higher accordingly.

In another establishment where storage is the adjunct, one 15-horsepower motor only is used driving two similar tumbler wheels and fans, and one large elevator for raising furniture, etc., to the third floor. The elevator use is comparatively very small, so that it does not materially affect the figures.

| | Yards. carpet. | Kilowatt-hours. | Kilowatt-hours per 100 yds. | Cost per yard, cts. |
|---|---|---|---|---|
| Jan. | 2,942 | 76 | 2.5 | 0.510 |
| Feb. | 4,617 | 164 | 3.5 | 0.355 |
| March | 6,907 | 206 | 2.9 | 0.298 |
| April | 17,820 | 489 | 2.7 | 0.274 |
| May | 64,129 | 1,661 | 2.5 | 0.170 |
| June | 52,461 | 1,172 | 2.2 | 0.178 |
| July | 22,222 | 459 | 2.1 | 0.206 |
| Aug. | 9,436 | 348 | 3.7 | 0.247 |
| Sept. | 15,248 | 363 | 2.3 | 0.238 |
| Oct. | 21,232 | 497 | 2.3 | 0.234 |
| Nov. | 23,455 | 584 | 2.4 | 0.224 |
| Dec. | 7,226 | 175 | 2.4 | 0.242 |

Total 247,246 yards cleaned at an average cost of 21.4 cents per 100 yds.

Input tests of the motors on the various machines show the following figures:

| | |
|---|---|
| Air compressor against 50 pounds pressure | 6.7 Horsepower |
| Weaving room, average conditions | 3.0 Horsepower |
| Carpet beater | 7.1 Horsepower |
| 12 by 8 feet tumblers with fans—loaded (Maximum) | 15. Horsepower |
| (Minimum) | 7.89 Horsepower |
| Large carpet wheel—loaded | 4.29 Horsepower |

Before the adoption of motors, this establishment was operated by a combination of gas and steam engines, at an expense of about $1,800 per year.

Electric drive and central-station service has reduced the power cost to less than $1,200.

In Chicago there is located an interesting carpet-cleaning plant which may be considered typical of the small establishments found in all parts of the country. This plant is in operation 10 hours per day during three months of the year, usually March, April and May, during which time about 2,000 yards of carpet are cleaned per day. The plant employs four men during this busy season, two measuring and cleaning and two delivering. During the remainder of the year, perhaps with the exception of October, the work is very intermittent, two men being employed for part of the day.

The rugs or carpets, received at the plant for cleaning, are revolved from one to one and one-half hours in a wooden reel having many projecting edges. These edges beat out the dirt which is drawn into a settling room by a 36-inch exhaust fan operating at 600 revolutions per minute. There are two cleaning reels installed, one being 12 feet in diameter and having a capacity of 250 yards, and the other 14 feet in diameter and having a capacity of 300 yards.

Both cleaners and the fan are operated from a line shaft driven by a 7.5-horsepower, three-phase, 60-cycle squirrel-cage motor running at 1,120 revolutions per minute. The speed of the smaller reel is 170 revolutions and of the larger 150 revolutions per minute.

Energy is supplied by the Commonwealth Edison Company, the average consumption per month being 185 kilowatt-hours. This gives an average monthly load-factor of 4.5 per cent.

Another plant, somewhat smaller, uses a five-horsepower motor which is connected to a Non Pareil 12 by 12-foot carpet-cleaning reel, operating at 22 revolutions per minute; and a 20-inch 1,100-revolutions-per-minute disk fan used for blowing dirt into the adjoining dust room. The motor is a three-phase, 60-cycle, 220-volt squirrel-cage machine running at 1,700 revolutions per minute.

This plant cleans carpets and rugs and makes rag rugs though no power is used for weaving. Energy is supplied by the local central-station company. The average consumption per month is 130 kilowatt-hours and the average monthly load-factor is 4.7 per cent. Other data are given in the accompanying data sheet.

# Commercial Practice
# Management, Rates, New Business

### A Farmer's Estimate of Electricity.

About a mile south of Rochester in Avon Township, Oakland County, Mich., is situated "The Cloverdale Holstein Dairy Farm," owned and managed by Robert Cassels. Two years ago the Eastern Michigan Edison Company built one of its 4,600-volt distribution lines past this farmer and his neighbors, most of whom proceeded to have their houses and barns wired and to use electricity for various purposes about the farm. Foremost among these consumers was Dr. Cassels. Scarcely had the current been turned on, than he had his house and barns wired and had purchased a motor.

The motor was a five horsepower, three-phase, 220-volt induction machine operating at 1,800 revolutions per minute. Dr. Cassell put the motor on skids, so as to be easily movable if necessary, and installed same in a shed centrally located among his farm buildings. It was belted to a jack shaft which protruded from the building, thus permitting the operation of machines which could not be conveniently operated indoors.

Dr. Cassels has used this motor for two years for grinding feed, cutting ensilage, husking corn, cutting wood and pumping water. He proposes to install this summer in addition, a corn sheller and an emery wheel. His farm contains 53 acres and Dr. Cassels, an expert veterinary surgeon and a man of education, has attacked his power problem in a common sense way which deserves consideration.

In the first place Dr. Cassels ascertained that the rate for power was four cents per kilowatt-hour, less 5-per-cent discount for prompt payment, with a minimum bill of $1.00 per horsepower connected per month. In other words his minimum bill for power was

$4.75 per month. He saw that he was entitled to 125 kilowatt-hours for this $4.75 and proposed to get his money's worth. Consequently he informed himself about the reading of his meter and, month by month, kept close account of his power, his output, and his costs. He planned his power operations in such a way as to consume, as nearly as possible, his 125 units per month and by using his head, has managed to do practically all of his power work at an average cost of $5.48 per month for two years, his maximum bill being $8.28. Moreover, by doing custom feed grinding and ensilage cutting for his neighbors, he has earned enough by his motor to pay a large part of his lighting and power bills. His motor cost him about $75.00 installed and his old gasoline engine had cost him about $150.00. The following letter written by Dr. Cassels was made public by G. D. Slaymaker in a paper on the subject of "Electricity on the Farm," presented before the recent convention of the Michigan Section, National Electric Light Association. The figures given are of exceptional interest.

"Cloverdale, Holstein Dairy Farm.
"Rochester, Mich., June 2, 1912.

"To the Eastern Michigan Edison Company,
"Rochester, Michigan.

"It is with pleasure I submit to you a correct estimate of the cost of current for the operation of the following farm machinery. The same being operated by myself with a five-horsepower electric motor as my farm power equipment.

"First:—

"An International feed grinder, with an eight-inch grinding burr, run at 600 revolutions, can grind one ton per hour of the heavy grains, such as shelled corn, barley or wheat, and 1,200 pounds of oats. The cost of same is two and one-half cents per hundred-weight.

"Second:—

"A No. 1 Whirlwind ensilage cutter with blower, having a cutting and elevating capacity of six tons per hour which I have fully developed at a power expense of fifteen cents per hour and run at 900 revolutions.

"Third:—

"A two-roll Appleton husker, through which I have husked 400 bushels of corn in ten hours at a cost of $1.60. This machine is run at about 1,000 revolutions and is equipped with cutter head and blower.

"Fourth:—

"A buzz-saw which will handle 40 cords of wood in ten hours at a cost of five cents per cord.

"A pump which I run at a power cost of two cents per hour. This pump has a capacity of 72 gallons per hour.

## Electric Motor Versus Gas Engine.

The rapidity with which the electric motor has ousted the gas engine and stopped its progress is one of the most remarkable features of recent industrial history. A few years ago the gas engine confidently challenged the electric motor; nowadays the only direction in which the gas engine has any field worth talking about is where electric power is not available.

Recently, in a large industrial center, there was a firm which adhered tenaciously to the gas engine. It was a conservative firm, which regarded the electric motor as a new-fangled arrangement which was a great deal too good to be true.

For a long time this firm resisted the arguments in favor of electric driving, but at last it consented, under protest, to a trial installation in part of the works driven by a single gas engine. Very careful records were kept of the performance of both; and the following was the result of the comparison, both as regards capital expenditure and running costs.

COMPARISON OF ACTUAL FIGURES OF GAS PLANT AND MOTORS RUNNING UNDER IDENTICAL CONDITIONS.

| | |
|---|---|
| GAS PLANT, 26 HORSEPOWER. | |
| Capital cost, including installation and foundations | $1,070.00 |
| Interest, 5 per cent. | 53.50 |
| Depreciation, 10 per cent | 107.00 |
| Oil | 61.00 |
| Attendance | 92.50 |
| Water | 7.30 |
| Maintenance | 53.50 |
| Gas | 340.00 |
| | $ 714.80 |
| MOTORS, 30 HORSEPOWER. | |
| Capital cost | $ 390.00 |
| Interest 5 per cent. | 19.50 |
| Depreciation 5 per cent. | 19.50 |
| Oil | 2.40 |
| Attendance | 4.90 |
| Maintenance | 9.70 |
| Electricity | 457.00 |
| | $ 513.00 |

When we add to this direct saving the enormous incidental benefits of electric driving—the simplicity, convenience, reliability, absence of vibration, instantaneous control in starting up, saving in space, and so on—there can be no doubt about the economy of the electric drive. This demonstration was so convincing to the firm that the other gas engines were straightway condemned to the scrap heap.

## Denver Company Replaces Tungstens.

The Denver Gas & Electric Light Company has announced that tungsten lamps used by merchants for window illumination will be replaced without charge, in case of damage. This concession applies, however, only to those patrons of the company who use current on what is known as the flat rate.

The Gas and Electric Committee of the Denver Retail Association is responsible for the change in the company's position.

## The Pulmotor at Louisville.

Impressive results are being secured in Louisville, Ky., through the use of the pulmotor, which was recently installed by the Louisville Lighting Company, and which is placed at the service of anyone when a case requiring its use develops. The pulmotor is located at the Sixth-street stables of the company, and is kept charged and ready for use. The fire department and police headquarters of the city are a short distance away, and when it is learned that a person has been overcome by asphyxiation, drowning or smoke, the pulmotor is carried by automobile to the scene and put into action. Sometimes as many as half a dozen calls a day are received for it. Officials of the company have secured considerable publicity for the machine, so that it is now generally known that it can be had without cost.

## Motion-Picture Advertising.

The commercial department of the Louisville & Northern Railway & Light Company, of New Albany, Ind., which in company with the United Gas & Electric Company and associated public-service companies of that city is carrying on a systematic campaign of publicity favoring Southern Indiana in general and New Albany in particular, has arranged for the use of moving pictures as part of its campaign. About 500 feet of film have been made by the Municipal & Commercial Film Company, showing scenes along the lines of the company, and featuring views of the Ohio River and Silver Hills, in the "knobs" back of New Albany. The film will be exhibited, in connection with other pictures made by the company in and around Louisville, at theaters all over the country.

## Central-Station Bargains.

It has been suggested that one of the reasons why central stations are not more successful in the sale of current-consuming devices is because their sense of dignity prevents them from resorting to the effective "bargain idea" in the exploitation of their goods. If this is the case, the advertising campaign now being carried on by the Nashville (Tenn.) Railway & Light Company should be more successful than the average, for it is using low prices and bargain offerings as a basis for a number of its pleas for business. A recent ad of this type was as follows:

"Special—On sale this morning. We will place on sale this morning fifty regular $3.75 demonstrator electric flatirons at $2.15. These irons are guaranteed for one year. Here's an opportunity to save $1.60—a real bargain.

# Electrical Construction

## ELECTRICAL CONSTRUCTION IN DEPARTMENT STORES.

### Notes on Equipment and Installation.

In the modern department-store building the circuits for supplying electric service are generally run in conduit, and, as a rule, the conduit is concealed. From a main switchboard located at some convenient point in the basement, horizontal runs of large conduits extend to the bases of large wire shafts provided for the vertical risers of the wiring system. Each wire shaft is usually rectangular in cross-section, and extends vertically from the basement to the top floor of the building. There is generally a door in the side of the shaft on each floor, the reason for which will appear presently. The number and sizes of the wire shafts depend upon the size of the building and upon the number of circuits to be run to the various floors.

From the base of each shaft, conduit risers extend upward within the shaft, the number of tubes being decreased continuously as successive floors are passed. On every floor the shaft contains a metal cabinet, made accessible by the door just mentioned, and in this there is a distributing board from which circuits for that particular floor radiate.

Where the building has direct-current service, it is good practice to provide a separate conduit for each one of the large cables in the circuits between the main switchboard and the various distributing boards. The smaller conductors are run several in one pipe.

In the design of a wire shaft adequate means should always be supplied for supporting the conduits and the conductors in them. Good, stable support may be had by attaching iron frames at the proper intervals to I-beams crossing the shaft. The frames may be built with horizontal cross bars drilled to receive U-bolts and bolts for holding cleats, flat iron bars being used. When a set of cables passes through a cabinet, the cables are generally supported by means of porcelain cleats.

It is customary to run lighting and power circuits separate, and to supply separate distributing panels, each in its own cabinet, for lights and for motors. Attention will be called later to a standard type of motor panel.

The foregoing remarks are meant to give a general notion of the best arrangement of circuits for department-store service. It should be explained here, perhaps, that this arrangement possesses many points in common with the design of circuits for large buildings of other types. For the sake of a more specific discussion of electrical work in department stores, some account of portions of the installations in two or three recently equipped buildings of the kind in question will be given. Switchboard equipment will be taken up first.

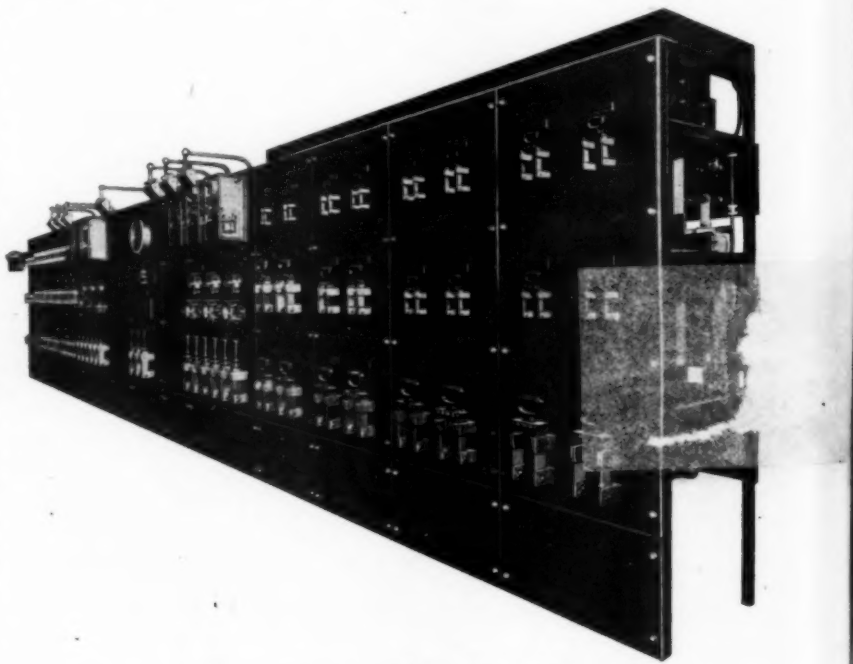


Fig. 1.—Front View of Switchboard—Rothschild & Company's Store.

The electrical installation in the new building for Rothschilds & Company's store, Chicago, which is now being completed, is said to be the largest job of electrical work, from the standpoint of cost, undertaken in this city since the completion of the Chicago & Northwestern Terminal Station. Fig. 1 is a front view of the main switchboard in this store. Fig. 2 is a rear view of the board, and Fig. 3 contains a diagram of the small wiring on the back of the board. This switchboard is 35 feet and 8 inches long, and 7 feet and 6 inches in height. The panels are of Monson slate, the main panels being 2 inches in thickness and the fuse panels 1.5 inches. There are 13 of the main panels. This number includes two narrow panels which are blank, there being one of these on either side of the central panel. The reason for supplying these blanks was to make room for changes in the board in case the company should ever decide to stop using central-station service and install its own power plant. In such an event generator panels can be readily substituted for the present service panels and the two blanks just mentioned.

The electric service for the Rothschilds store is supplied from the three-wire underground, direct-current distributing mains of the Commonwealth Edison Company, at 250 volts between the positive and the negative sides of the circuit. Three neutral cables run to single-pole single-throw switches on the central panel of the switchboard. On the right of this is the positive service panel, which has six similar switches, to each one of which a positive service cable is brought. To the left of the center is the panel to which the six negative

cables of the service are connected, through six single-pole single-throw switches. Each of the 15 incoming cables has a carrying capacity of 1,500 amperes, and they are all lead-covered and paper-insulated. Every cable is protected from short-circuits with a 1,200-ampere all-copper link fuse, on the back of the switchboard. These cables are run from a special manhole built for this service, which manhole is tied in electrically to three different substations.

It will be readily seen that with an electric service of such a design as that just described, any possibility of a temporary interruption of the power supply is extremely remote.

Fig. 2.—Rear View of Switchboard.

Four panels on the left of the center of the switchboard shown in Fig. 1 have three-pole switches for the control of lighting feeders, these feeders being run three-wire to the distributing boards on the various floors. On four panels in the right-hand side of the board, there are two-pole switches for the control of power feeders. The power feeders are all run as two-wire, 220-volt circuits to the power control boards. All lighting and motor feeders are fused on the switchboard with National Electrical Code standard fuses, some of the fuses being as large as 1,000 amperes in capacity.

From Fig. 2 a fair idea of the arrangement of bus bars on the rear of the switchboard may be obtained. The bars are all built up of one-eighth-inch copper laminations, with one-eighth-inch ventilating spaces between each two laminations. Studs are provided of the proper type and in the proper number to avoid the use of bent bus-bar connections. There are about 4,000 pieces of copper on the back of the switchboard, the aggregate weight of these being 6,000 pounds or more. All switch, fuse and instrument studs are covered with fiber tubing a sixteenth of an inch thick, red tubing being used for positive studs, black for negative and gray for neutral.

Convenient terminal lugs are provided at the bottom of the switchboard for the incoming service cables, while at the top of the board there are similar provisions for making connection to all feeder circuits. Thus the inconvenience and unsightliness of extending heavy cables up or down among the bus bars is eliminated.

The requirements for measuring the power consumption in a department store naturally differ from those in buildings of other types. In an office building, for example, a record must usually be kept of the power consumed by the various tenants, and hence small meters must generally be installed in relatively large numbers on each floor. In department-store work, however, all necessary meters may, as a rule, be placed on the main switchboard. On the board described in the foregoing there are two 1,200-ampere Thomson series meters used in parallel on each side for measuring total lighting power, and two 1,500-ampere meters similarly connected on the power circuits. These meters were made by the General Electric Company, and each of the six is provided with a printometer, supplied by the Minerallac Electric Company, of Chicago, for keeping a record of the maximum demand for power on the central-station lines. There are also six Sangamo watt-hour meters for measuring the power supplied to certain departments. A Weston voltmeter mounted on a bracket at one end of the board is employed to indicate the voltage between the two sides of the three-wire system and also between the neutral and the outside of the circuit. The connections are shown in Fig. 3. Flush push-button switches on the front of the board control bracket lights for illuminating the board and instruments.

The specifications for this switchboard were drawn by Frank H. Getchell, electrical engineer for Holabird & Roche, Chicago, and the board was built by the States Electric Company, of Chicago, as were also the distributing panels and cabinets used in the building. Holabird and Roche are the architects in charge of the erection of the building. The electrical work is being done by L. K. Comstock & Company, of Chicago, under the personal direction of Mr. Getchell, the electrical engineer.

**Distributing Panels and Branch Circuits.**

Another large department store in Chicago for which a new building is being completed is that of Mandel Brothers. The architects and the electrical engineer just mentioned are also looking after this job, and the electrical work is being done by A. S. Schulman, electrical contractor, of Chicago. Fig. 4 is a photograph of a part of the interior of one of the wire shafts in this building, showing one of the sheet-metal cabinets for a distributing panel. Crossing the panel horizontally there are narrow ledges which project, in horizontal planes, toward the front side of the box. These are drilled, and pieces of angle iron are bolted to them. The vertical part of the angle iron is drilled for bolts to be used in holding porcelain cleats in place. Some of these cleats may be seen in the photo-

graph. Single-wire cleats are employed for supporting the large cables, and each cleat is reinforced, on the outward side, with a strap of iron having a hole in each end through which the bolts are passed. The cabinet shown in the figure is in the upper part of the shaft where the number of circuits has become so small that the conductors can all be run through the cabinet itself. The switch and fuse panels, which are of the type shown in Fig. 5, will be installed in the cabinet against stops provided for the purpose just in front of the side doors, one of which is seen standing open at the left-hand side of the box. The taps from the three-wire risers are then run through holes in the slate and

best type of construction is employed, ample provision will be made for floor circuits, as well as for circuits to the ceiling. Such circuits are needed to supply current to floor receptacles for attachment plugs and for showcase lighting. In the two installations mentioned in this paper, floor-boxes are installed at frequent intervals. In the tops of these there are attachment plug receptacles, and from the sides there pass circuits, in the floor, to points underneath showcases, where the conduit turns upward into the showcase. Floor and ceiling circuits are controlled from separate parts of the distributing panel.

In the Rothschild store, independent circuits are run from the main switchboard, in the basement, for window lighting. These terminate in control cabinets located at convenient points near the windows. Here the circuits are properly fused and equipped with the necessary switches. Numerous floor receptacles are installed in the windows, and the circuits to these run from a panel separate from that supplying overhead window lights, although the panels are in the same cabinets.

Cutout cabinets for motors are usually located in the motor room, and independent circuits run to them from the main switchboard. Fig. 6 is a photograph of such a cabinet in the room occupied by the elevator motors in the Rothschild store. This board was also built by the States Electric Company, of Chicago. It is interesting to note that the motor switches are between the busbars and the fuses.

The motor installation in the Rothschild store includes, in addition to those for operating the twenty-four passenger elevators and various lifts and freight elevators, units for driving the laundry machinery, running the refrigerating plant, operating the heating and ventilating systems, and so on. Motor-driven fans for ventilation and heating handle 600,000 cubic feet of air per minute.

There are also motor-generator sets for supplying current to signaling and telephone circuits.

**Lighting.**

The Rothschild store is lighted throughout with single-lamp tungsten units dropped from the ceilings by means of ornamental chain fixtures. Luceo reflectors are employed. On the first floor, where the ceiling is high, 250-watt lamps are installed, but toward the top of the building smaller units are used. More lamps are installed than are used at any one time. This liberal allowance of lighting units is a very wise one for department-store service, because of frequent changes in character and arrangements of goods which are almost sure to occur on any floor.

As already intimated, lamps for lighting stairways, exits and the like should have separate control from those used in lighting the body of the store. The stairway lights in the store last mentioned are controlled by means of locked switches on the landings.

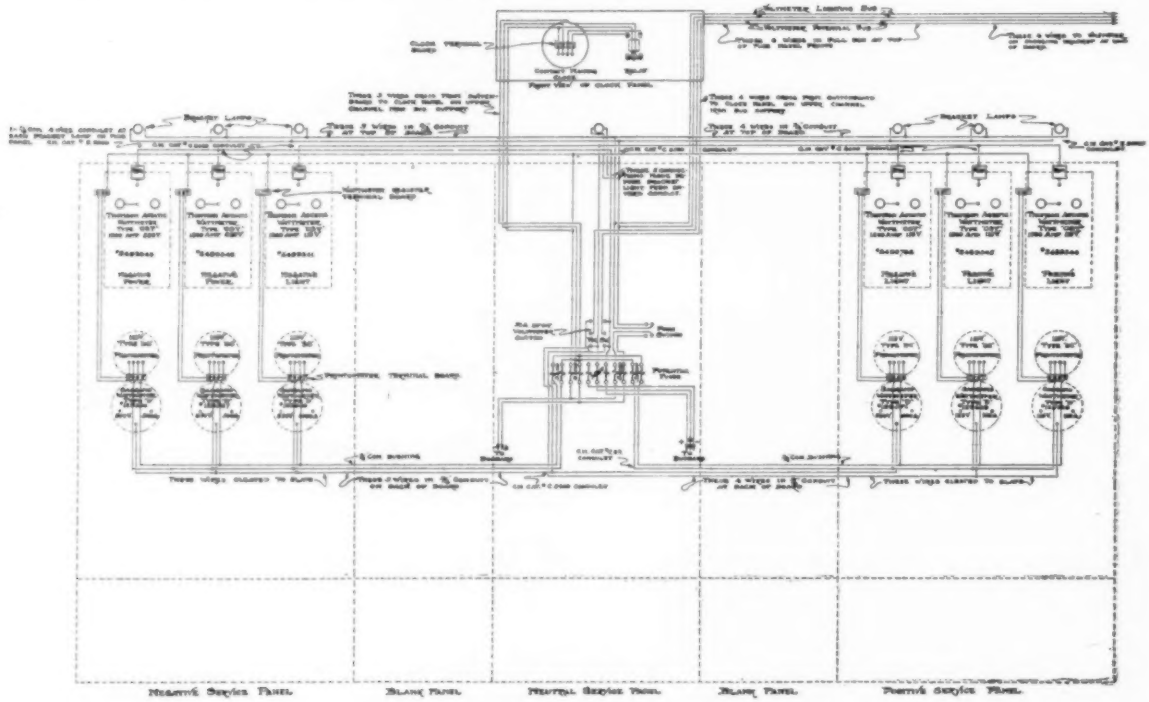


Fig. 3.—Wiring Diagram of Service Panels.

properly connected, as are also the branch circuits for service on the floor. Taps from the risers and the ends of conductors for circuits on this floor are shown in Fig. 4. The three-wire circuit seen passing upward on the right, with all three conductors brought up in one pipe, will supply current to exit and other emergency lamps. When the distributing board is narrow, the side doors provide sufficient access for all work which must be done behind it. Where it consists of several panels, open spaces are left between these until all connections have been made, after which the spaces are closed with slabs which fit them snugly.

Branch circuits from a distributing panel are run two-wire, of course, and are protected with plug fuses. If the

A portion of the stock room of Mandel Brothers' store is to be lighted with drop lamps on flexible cords, this arrangement being thought desirable because goods are to be piled to the ceiling, in piles which will extend at frequent intervals across the room. From the ceiling outlets in the conduit system here, circuits in wooden molding extend in all necessary directions. One-piece molding rosettes support the drops. The ceiling outlet boxes will be covered with neat looking canopies. While this construction does not seem to be the best one that could be used here, it is an interesting case of mixed wiring.

**Exposed Conduit Wiring.**

In Seigel Cooper & Company's department store, in Chicago, there was formerly an old system of arc lighting and open wiring. This was replaced not long ago with a complete system of exposed-conduit circuits, and the appearance is not at all unattractive. This installation, which was designed by Sargent & Lundy, and installed by Kohler Brothers, all of Chicago, is particularly interesting as showing what can be done with work of this sort. There are those, it may be added, who favor exposed conduit work for department stores, because of the ease with which extensions and changes can be made in it.

Fig. 4.—View of Interior of Wire Shaft.

**Miscellaneous Applications.**

A long paper could be written on the miscellaneous uses of electricity in the modern department store. Only brief mention will be made of a few of these here, however.

In the Rothschild store the telephone and signalling systems, the circuits of which are run in conduit, are generally supplied with energy either from small motor-generator sets or from storage cells charged from these. The signal systems will include a manager's-call system, a dismissal-bell system, and an automatic credit system.

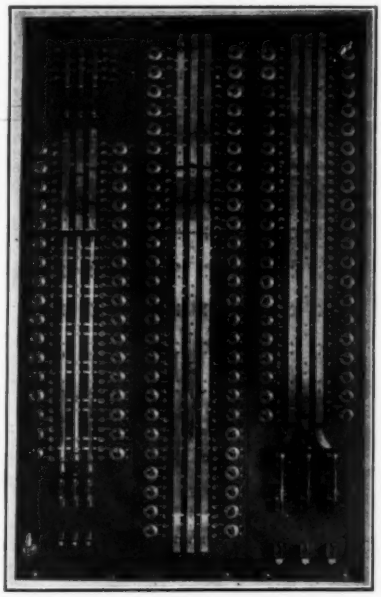


Fig. 5.—Distribution Panel.

In the system first mentioned, there are a number of colored lights on each floor used to summon various officials to the telephone whenever necessary. For example, when the house detective is wanted in a given part of the building, the switchboard operator is so informed over the telephone, and she throws a switch which lights a red signal on every floor. Seeing this, the detective immediately inquires of the operator, over the telephone, where he is wanted.

The credit-signal system makes it possible for a clerk in a central office to stamp electrically on a ticket at convenient points on every floor, the credit standing of any customer about whom a salesman may be awaiting instructions. The clerk looks up the customer's record and stamps it on the salesman's ticket by pressing electric buttons.

In addition to the other parties mentioned already, the writer wishes to thank H. A. Slaney, engineer for Rothschild & Company, for courteous assistance in collecting the data used in this paper.

## Plugging Gas Outlets.

It is often desirable when wiring an old house to plug up all old gas outlets in back of the wall. This can be done by unscrewing the nipples from the ell or tee and putting plugs in the place of these.

## Wiring Ordinance in Seattle.

There is in force in Seattle an ordinance relative to electrical construction within the city which possesses interesting features not usually incorporated in ordinances of the kind. This ordinance covers the specifications for wiring materials much more fully than is customary elsewhere than in the Code itself. Specifications for rubber-covered wire, fixtures, knobs, sockets, conduit, outlet boxes, transformers, flexible cord and various other fittings and appurtenances of the electric circuit are given in minutest detail. These all conform essentially to the requirements of the Code, there being certain extra requirements which are necessitated by special local conditions.

The ordinance also provides that only metal-clad circuits may be used in buildings of certain types, and prescribes the necessary steps in obtaining permits for wiring and securing inspections.

It is interesting to note the relation of the electrical inspection department in Seattle to fire department. In case an installation of wiring within the city becomes hazardous, it is the duty of the city electrician to report this condition to the chief of the fire department, and the latter takes the steps necessary to have the use of the installation discontinued.

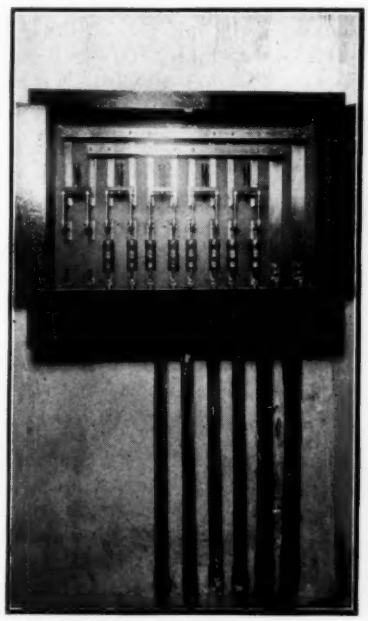


Fig. 6.—Fuse and Switch Cabinet for Elevator Motors—Rothschilds' Store.

The ordinance provides that all recording meters for measuring electric current for use in residences and apartment houses, must be so located that the consumption of electric current registered by said meters can be read by the inspector or meter reader without his being required to enter any locked or otherwise inaccessible portion of said residence or

apartment, unless otherwise approved by the city electrician.

It is also provided that only waterproof sockets may be used in wet or damp places and that these must be hung by separate stranded rubber-covered wires not smaller than No. 14, which must be twisted together when the pendant is more than three feet long. The pendant wires are required to be soldered directly to the circuit wires, but supported independently of them. Pendants are not allowed to come nearer than seven feet to the floor in any case where a shock might be obtained from them by persons standing on the floor.

The ordinance is especially specific, and fortunately so, concerning the use of flexible cord. It is pointed out that cord designed for pendant use must, under no circumstances, be employed for extensions not vertical, and that drops of this material must not come nearer the floor than six feet.

## Keeping the Commutator Smooth and Clean.

When the commutator on a direct-current motor becomes dirty and gummy, relief may sometimes be had by wrapping one group of the brushes with a piece of thick felt, so that the brush tension will hold the felt firmly against the commutator surface, and leaving the felt in position with the motor in operation. Canvas cloth may be used in place of felt. The cloth should be tied securely around the brushes with a strong string. As soon as the commutator has acquired a bright, glazed surface, the cloth should be removed.

The cloth being an insulator, it may be impracticable to wrap all the brushes in one group, where the number of groups of brushes on a machine is small. In such a case, the desired results may usually be obtained by wrapping one brush in one group and another brush in another group not tracking with the first, and so on until the entire surface of the commutator is rubbed with the cloth while the armature is rotating.

This practice is employed regularly by H. J. Slaney in a large motor installation in Chicago, and he finds it to give splendid results.

## Motor Trouble Caused by Defective Keying of Armature and Commutator.

An instance is related in which great difficulty was experienced in locating the cause of the trouble when the commutator on a direct-current motor began to spark and heat very badly. The armature was finally taken out, and it was then found that both it and the commutator were loose on the shaft. the driving keys which held the armature core and the commutator in place being worn. Relative motion of commutator and armature had broken some of the conductors loose where they were fastened to the commutator lugs.

## Joseph A. Fowler.

The gentleman whose photograph appears in this column is one of the leading electrical contractors of Memphis, Tenn. He is at the head of the Joseph Fowler Electric Company, of that city.

Mr. Fowler is very enthusiastic and optimistic concerning the outlook for the electrical business in the South, and has an abiding interest in every movement tending to promote improvement of conditions in the field of electrical contracting. His enthusiasm in these matters is by no means confined to his own state or his own section of the

Joseph A. Fowler,
Director National Electrical Contractors' Association for Tennessee.

country. He took a leading part in the organization of the Tennessee Electrical Contractors' Association, and is now the secretary of that body. He believes that the National Electrical Contractors' Association is doing a great work for the profession, and thinks that every firm of electrical contractors should be a member of the organization. Mr. Fowler himself is one of the directors of the National Association.

Mr. Fowler has been engaged in electrical work continuously during the last fifteen years or so, and has been in business for himself for three years now. He finds that it pays him to conduct an electrical store in connection with his contracting business. His firm handles a large line of wiring and lighting supplies, and all sorts of electric heating and other modern electrical appliances and devices.

Mr. Fowler is pleased with the present tendency towards closer co-operation among contractors.

## Among the Contractors.

The Spengler Electric Construction Company, of Port Jervis, N. Y., has secured the contract for the electrical work in the new Young Men's Christian Association Building in that city. This is a four-story structure, and the cost will be $40,000.

Freeman, Sweet & Company, 538 South Dearborn Street, Chicago, is installing the wiring for 300 incandescent lamps and 60 motors for the Sawyer Biscuit Company, in Chicago.

The Wahlgren Electric Company, of Everett, Wash., is completing the installation of wiring and fixtures in the Realty Block of that city, the contract price amounting to about $1,200. The company is planning to move its place of business to new quarters in the near future.

Buxbaum and Cooley, electrical contractors, of Seattle, Wash., have lately completed the wiring and fixture work on the new Melbourne Theatre. This company is also doing the wiring on the four-story reconstructed Germania Cafe Building in Seattle.

A. M. Wilmersdorf, 4620 Vincennes Avenue, Chicago, is doing the wiring for an installation of 3,000 incandescent lamps in the Webster Building, Chicago.

The Union Electric Company, of Seattle, Wash., has recently opened a store and shop at 93 Columbia Street, for conducting a general electrical contracting, repair and supply business.

The United Electrical Construction Company, 417 South Dearborn Street, Chicago, is wiring the Nicholas Senn High-school Building. This is the largest high-chool building yet erected by the city of Chicago.

L. K. Comstock & Company, 402 First National Bank Building, Chicago, is installing the wiring for three generators, 130 motors, and a large number of incandescent lamps for H. C. Lytton, on North State Street, Chicago.

The E. A. Jones Electric Company, of Everett, Wash., has the contract for the installation of the wiring and fixtures in the new Everett Episcopal church building. This company has also recently finished the electrical installation at the plant of the State Milling Company, of Everett, consisting of 1,400 feet of rigid iron conduit and installing six motors ranging from 40 horsepower down to 5 horsepower.

# Dollar Wiring Kinks.

**Every reader is invited to contribute to this column. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; and if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.**

### Assembling Knobs.

I have found the following method to be a time saver.

On arriving at a job of knob-and-tube work I have the helper assemble the knobs with nails and leather-heads, if this has not already been done at the shop, and also place an additional leather-head on the nail at the bottom of the knob. This allows taking a quantity of them in the pocket of the overalls or apron, and they are all ready to use will.

G. Pendleton, Jr.

### Method of Installing Tubes.

I find the following a quick way, and an easy one, for putting wires through joists in knob-and-tube work

Instead of putting the tubes in the holes before the wire is threaded through, I slip them on the wire while it is being threaded, in the manner indicated in the figure. As the holes are bored at an angle, this allows the wire to be pulled in on a straight line. A much longer line can be pulled in in this way. After the wire is pulled in the tubes are slipped into place.

Fig.1.—Tubes Strung on Wire.

A. R. Cummings.

### Better than Electric Soldering?

I have tried a number of different kinds of heating devices while soldering armature coils to commutator bars and also when putting band wires on, and have failed to find anything that answers the purpose so well as the one I am now using.

I took a heating unit of an old discarded tailor's iron; and after doing some repair work on the unit itself, I cut several thicknesses of heavy asbestos board into just the shape of the top of the unit. Putting plenty of shellac between these, I placed them on top of the unit to protect the hand from excessive heat. In making a handle I raised it about twice as far away from the iron as such handles usually are.

This is proving to be the most useful tool I have ever found for sweating-in armature leads and soldering on band wires.

W. A. Hines.

### Pulling Small Wires Out of Conduit.

I often find it necessary to pull defective wires from conduits, and the job is by no means always an easy one. One cause of trouble is that, in most cases, the ends of the wire at the switch or outlet box are so short as to make it very difficult to get hold of them for a good pull. In such cases I make a very effective "come along" out of my pliers. I put at least two turns of my fish wire around them about half way between the hinge and the middle of the curved part of the handles, twisting the ends of this double turn so as to make the wire draw the jaws of the pliers closely together. I then carry another wire around this loop and also around anything that can be used as a lever in the manner shown in the figure. By slipping this double turn down over the joint of the pliers, they can be opened wide enough to take a duplex or a single wire without any trouble. It is then possible to get hold of and pull a wire or wires with the pliers, which would otherwise be almost impossible.

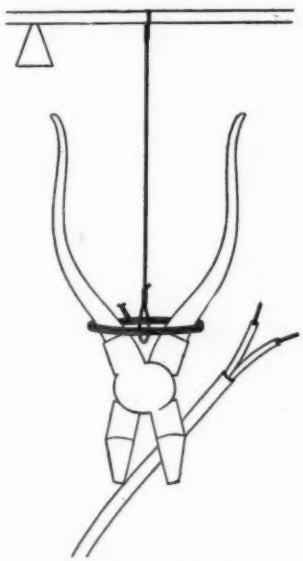


Fig. 2.—Arrangement of Pliers and Lever.

L. L. Newcombe.

### Peculiar Method of Repairing Spark Coils.

While repairing spark coils some time ago, I found one among them on which the secondary was open at some place inside the coil. As it is a very difficult job to melt all the wax, get the coil out and rewind it, I thought of trying a way which might avoid this and make the coil work just as well. I took a good spark coil, and sent the high-tension current of same through the one to be repaired for a few seconds, thinking it might jump across the break and carbonize some of the insulation, which would make a fairly good conductor for the high voltage generated. Sure enough, it gave as good a spark as the one I had used to perform the experiment, after this treatment. The coil has been in service for a few weeks and works very well.

Joseph Braith.

### Cutting Polished Tubing.

To hold any polished tubing for cutting or threading, bore a hole a little smaller than the tube to be cut through a block of wood. Then cut the block in two through the center of the hole. The two pieces thus formed can be clamped together in any vise and will hold a polished pipe or tube without marring or crushing.

J. C. Hewitt.

### Sharpening Brick Drill.

I have noticed in the Dollar Wiring Kinks several items in regard to sharpening brick drills. Most of these suggestions are in regard to filing the teeth. The best brick drill that I have found is made by taking the size of the hole that you want to drill and cutting the pipe on an angle of about 45 degrees with a hacksaw. This is much better and is very simple to make. If the pipe is a little too soft, it can be tempered. Above see diagram of about how to cut the pipe.

Fig. 3.—Brick Drill.

J. L. Mueller.

### Installing Side Lights.

In installing side lights on the second floor in old houses it is necessary at times to remove the base-board as the floor plate cannot be bored with the ordinary brace and bit. A simple way out of this is to invert a boring machine and bore the holes through the floor plate by placing the machine between the ceiling of the first floor and the floor of the second.

Charles A. Bergen.

## Colorado Coal Production.

The production of coal in Colorado in 1911 was 10,157,383 short tons, valued at $14,747,764. Colorado is the principal coal-producing state west of Mississippi River and ranks seventh among all the states, in the production of coal.

# Among the Supply Men

A very interesting communication was received recently by a purchaser of electrical material from a large manufacturer of a mechanical specialty. This has such a direct bearing on the mooted question of the position of the middle men or supply men, particularly as it is related to the electrical field, that it is published here for what it is worth. An abstract of this letter follows: "We manufacture for and sell exclusively to the electrical jobber of established standing, and never, under any circumstances, sell to the user, no matter how large. It is our belief that the user is much better off to buy from the jobber than to attempt to purchase from the manufacturer. The jobber has an established selling force, carries large stocks, issues catalogs, and in every way is equipped to serve the wants of the user and to take care of his every little requirement. By handling the entire electrical line the jobber is able to distribute these costs over a great number of articles, whereas the manufacturer, to reach the user, must incur an expense which applies only on his particular line. For this reason the manufacturer cannot begin to sell the user in the long run at as low a price as the jobber can sell him, and cannot give him anything like the service. Especially with as large a user as yourself, when you buy in quantities which get you so close a margin that a jobber hardly gets any profit out of it we think it is your duty to support some established jobber in your territory, so that he can be in position to always serve you on the innumerable small articles that the manufacturer could not possibly give you promptly as you require them, and which the jobber could not furnish you if he was not supported in the whole line by a large number of users.

"We are going into this at some length because we are the largest manufacturers in this line ourselves, and have had an experience of nearly 20 years, and this experience has so thoroughly convinced us that it is the duty of the manufacturer to sell exclusively to the jobber, and the duty of the user to buy exclusively of the jobber, that we cannot help expressing ourselves along this line when occasion permits. We realize that it occasionally looks attractive to buy a little closer direct from the factory than to purchase from the jobber, but we assure you that in our opinion the only result of this is to make it necessary for the jobber to charge you a higher price on the things that you must buy from him because you cannot wait to get them from the factory, with the uncertainties of factory delivery, and in the long run, the best service and the cheapest supply for you is from an established jobber.

"We are sure you will take this letter in the spirit in which it is written, and we hope you will favor some jobber with your business."

In this connection one of the largest supply houses in Chicago states that a part of its work daily is the effort to educate the customers to believe more completely that regardless of what is said of the middle men in other lines of business, it is a fact that the jobber in the electrical business is a positive necessity, and that it is also important to keep in mind the fact that at the end of ten years the total net profit as shown on the books of any jobbing house in the United States will be lower than that regarded as satisfactory by any other established line of business. They insist that the manufacturer should either sell to jobbers exclusively, or they should not sell at all, and the jobbers should see that they are sold through exclusively, or not at all, and it is only by meeting the issue squarely and completely that any success will be attained. They feel that in purchasing from jobbers the buyers get a service which the manufacturers cannot give. Therefore, even if the jobber's price is higher than the manufacturer's, it is not out of line.

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Agens & Hopper, Newark, N. J., are conducting special sales campaigns on tungsten automobile lamps, Ever-Ready flashlights and batteries, General Electric fixed, oscillating and ceiling fans, and Westinghouse wire-type tungsten lamps. They have added two more salesmen to their present staff in the local territory. Sales of galvanized conduit ("white pipe") have been greatly increased owing to the large amount of piping they have done in new buildings for vacuum cleaning systems.

The following were recently elected to membership in New York Electrical Credit Association: Independent Electrical Supply Company, 59 Warren Street, New York; Laco-Phillips Company, 131 Hudson Street, New York.

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The Commercial Electric Supply Company, St. Louis, Mo., reports unusual business from the territory which it covers including Indiana, Illinois, Iowa, Missouri and Arkansas. It is conducting special sales campaigns on high-grade commercial direct-current desk and ceiling fans, Emerson and Trojan alternating-current desk and ceiling fans, new commercial wire-drawn tungsten lamp and high-grade commercial push-button switch. This campaign has created a large number of special demands, and has also resulted in a big demand for new and re-built electrical apparatus. This company also does a large business in machinery.

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C. H. Price & Company, 419 S. Grand Street, Los Angeles, Cal., are pushing private lighting plants, and electric devices for household use such as electric stoves, irons, heaters, washing machines, etc. This company was established recently, and will act as manufacturers' agent, making a specialty of electric apparatus. If this company is able to secure a suitable location it proposes to open a store similar to the "Electric Shop" in Chicago.

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The Electric Appliance Company, 205-209 Chartres Street, New Orleans, La., C. Robert Churchill, president and general manager, reports that it is not conducting any special campaigns, but is hammering at the trade in its usual vigorous manner and getting some results which, all things considered, are satisfactory. This house travels a territory covered by Louisiana, Mississippi, southern Alabama, southern Georgia, and Florida, being well represented in these states by an able corps of "commercial ambassadors." These salesmen are not reporting any unusual business from any territory. During the coming year the house expects to get into a new building which will be erected especially for it. In the present quarters it is very much cramped for space, having outgrown these quar-

ters, and it has been found necessary to not only materially strengthen the building, but secure additional warehousing facilities.

G. E. Watts, the southern sales agent of the Electric Service Supplies Company, of Philadelphia, with headquarters at Atlanta, Ga., is the regular traveling representative for this company, covering the southern states and Cuba, selling all classes of street-railway material. Mr. Watts is also the southern representative of the R. D. Nuttall Company, of Pittsburgh. Mr. Watts reports railway business very active at all southern points, and there seem to be larger appropriations made for extensions, reconstruction and new equipment than have been available in the South for many years. Mr. Watts missed the special sales meeting which was held in Philadelphia, June 14 and 15, he being then in New Orleans.

# Public Service Commissions

## WISCONSIN.

By its decision in the case of the Calumet Service Company versus the City of Chilton, the Supreme Court has definitely fixed the status of the indeterminate-permit provision of the public-utility law. There has been some question as to the scope of the exclusiveness granted by the indeterminate permit in cases of municipalities who may desire to do their own lighting. In the present case, the Calumet Service Company was performing its public-utility duties under an indeterminate permit issued by the Railroad Commission, when the city sought to invade the field claimed by the company to be exclusive, claiming rights under statutes which antedated the public-utility law. The company appealed for an injunction restraining the municipality from entering the field and the trial court decided against the city. The case went to the Supreme Court and it was there held that the exclusive privilege which the company enjoyed by virtue of the indeterminate permit excluded the city from going into the lighting business, even to the extent of doing its own lighting. Therefore, in order to go into the lighting business itself when another utility is in the field and operating under an indeterminate permit, a municipality must either take over the existing plant at a price fixed by the Commission, or else convince the Commission that public convenience and necessity require a second utility because efficient, adequate service at reasonable rates is not obtainable under existing conditions. In connection with the above case, an attempt had already been made to secure a certificate of convenience and necessity for the establishment of another utility, but the certificate was refused by the Commission on the ground that the service being rendered by the existing utility was satisfactory.

In order to provide for public safety, the Commission has ordered the Paramount Power & Realty Company, which recently purchased a dam and water power at Beaver Dam, to repair and strengthen its dam. While there is no immediate danger, a sudden strain on the dam might result seriously to the section of the city located immediately below the dam, and below the lake level.

In orer to enable the Wisconsin Telephone Company to purchase and acquire all the property and effects of the Fox River Valley Telephone & Telegraph Company, the Commission has authorized the company to issue $200,000 of its notes to apply on the purchase price of $335,000. The property involved consists of eight exchanges together with all of the connecting lines.

The Commission has received applications from the Wisconsin Electric Railway Company and the Eastern Wisconsin Railway & Light Company for an order authorizing them to establish an amended schedule of fares on their interurban lines, in lieu of the schedule of charges by fare zones which is now in effect. The amended schedule is to be based upon a uniform charge of two cents per mile. There is now pending before the Commission a proceeding in which the present schedule of rates charged for transportation upon the former company's lines is attacked as being excessive and discriminatory. The Commission will take testimony upon both application on July 9.

## OKLAHOMA.

On account of the additional expense involved, the Pioneer Telephone & Telegraph Company has protested to the Corporation Commission against the order which would require all companies to mark their poles and other structures with some distinguishing mark that would identify them as company property. J. F. Noble, for the Pioneer Company, said that to comply with the order would entail an expenditure of not less than $11,800, or that it would cost $14 per pole. George P. Player, telephone engineer of the Commission, says that the same thing has been done by telephone and telegraph companies in New York at a cost of $2.50 per pole.

## NEW YORK.

The Public Service Commission, Second District, has denied the application of the Philmont Lighting & Power Company for approval of franchises granted it by the village of Philmont, Columbia County. At a hearing held by the Commission, the president and all the trustees of the village of Philmont objected to the approval of this franchise, which was granted by the village board five years ago. They stated it was their desire that the entire lighting situation in Philmont be reopened and two other companies be given an opportunity to make propositions to the village for the furnishing of electric light.

The Commission has authorized the Tri-County Light & Power Company to exercise franchises granted by the town of Gilboa, Schoharie County, by Prattsville, Greene County, and Roxbury, Delaware County, for the furnishing of electric light, heat and power in these communities.

The Commission has authorized the Fulton County Gas & Electric Company to issue two-year, six per cent gold notes to the amount of $36,000. The proceeds of the notes are to be used for various additions and betterments to the plant of the company.

The Commission has authorized the Oneonta Light & Power Company to issue its five-year five-per cent bonds to the par value of $25,000. The proceeds of the bonds are to be used for the payment of accounts outstanding which were incurred for proper capital purposes.

# American Institute of Electrical Engineers.

## Report of Twenty-ninth Annual Convention, Boston, Mass., June 24 to 28.

The twenty-ninth annual convention of the American Institute of Electrical Engineers, which was held at Boston, Mass., June 24 to 28, was one of the most successful that has ever been held by the Institute, very complete arrangements having been made by the Local Committee both for the holding of meetings and for the entertainment of those attending the convention. The attendance came near reaching record figures, the total registration amounting to 934. In spite of the hot weather which visited Boston during the convention week, interest was sustained up to the last session of the convention.

The headquarters for the convention were at Somerset Hotel, in which all of the sessions were held. The convention opened with a reception and dance in the Grand Ball Room on the evening of Monday, June 24. Sessions for the reading of papers were held on Tuesday morning, Wednesday morning, Thursday morning, Friday morning and Friday afternoon.

On Tuesday afternoon visits were made to the power stations in South Boston of the Edison Electric Illuminating Company and the Boston Elevated Railway Company, the return being made by steamboat through Boston Harbor. In the evening the members and guests attended the Pop concert of the Boston Symphony Orchestra. On Wednesday afternoon visits were made to the Massachusetts Institute of Technology and to Harvard University. On Thursday afternoon a visit was made to the Lynn works of the General Electric Company.

Entertainment was provided for the ladies in addition to the above as follows: a lunch trip to Nantasket Beach on Tuesday, a theater party on Wednesday evening, and an automobile trip to Lexington and Concord, with luncheon at the Vesper Country Club, on Thursday.

### Banquet and Presentation of Edison Medal.

On Thursday evening the Institute banquet was held in the Grand Ball Room and presentation of the Edison medal was made to George Westinghouse. President Gano Dunn acted as toastmaster, and after proposing a toast to the President of the United States, called upon Lieutenant-Governor Robert Luce, to make the first address, on "The State of Massachusetts." He was followed by Michael I. Pupin, who responded to the subject "Electrical Engineering." Elihu Thomson made an address in presenting the award of the Edison Medal Committee and Mr. Westinghouse made a brief but heart-felt acknowledgement. President-elect Ralph D. Mershon made the concluding speech on the subject "The Institute." Telegrams of regret of inability to attend were received from Thomas A. Edison, Edward Weston, Dugald C. Jackson, Samuel Sheldon, F. M. Tait and D. B. Rushmore. President Dunn complimented the chairman of the Local Convention Committee, C L. Edgar, as well as the chairman of the subcommittees, Louis D. Gibbs, Charles B. Davis, F. P. Valentine and W. H. Blood, Jr., upon the excellence of the arrangements for the meeting and expressed the thanks of the Institute for their efforts.

The opening session of the convention was called to order by President Gano Dunn at 10:15 a. m. on Tuesday, June 25. The first order of business was the delivery of the president's address, which dealt with the subject "The Relation of the Profession of Electrical Engineering to Other Occupations."

The development of the engineering was traced from the earliest times down to the middle of the eighteenth century, at which time modern engineering may be said to have begun. Today there are 28 recognized classes of engineers, covering all kinds of applications. The knowledge of the engineer is specialized and has been acquired so fast that it is not widely distributed. In the future this knowledge will become more general so that the engineer will no longer be distinguished by his *knowledge*, but by his *method* of applying knowledge to human uses. Engineering will then no longer be regarded as a profession, but engineering methods, will be applied in all professions and occupations.

The President then introduced Ralph D. Mershon, president-elect, who made a brief address, thanking the members for the honor which had been conferred upon him and which he deeply appreciated. He said that the success of the Institute had been due to three things: (1) the men who had been doing the work of the Institute are the ablest among the membership; (2) there is friendly rivalry to see who can do the most for the advancement of Institute welfare; (3) the men who do the work of the Institute receive credit for it. He wound up his address by appealing to the members for their co-operation and likened himself to the leader of an orchestra whose business it is to wave the baton, but whose success depends entirely upon the co-operation of the members of the orchestra who must all do their respective parts and "sing in tune."

The presentation of a past-president's badge was then made to D. C. Jackson, who was not present at the meeting as he is now in Europe. He was represented by his brother, John P. Jackson, who received the pin for him and made a suitable response. There was then a short recess, during which the meeting broke up into parallel sessions, one dealing with papers on high-tension transmission and the other devoted to electrochemistry and electrophysics.

### High-Tension Transmission.

This session was called to order by President Dunn immediately after the close of the opening session. Three papers dealing with high-potential experiments were presented and were discussed together. The first was by C. Francis Harding on "Determination of Corona Losses at High Potential." The next was by F. W. Peek, Jr., and was entitled "Dielectric Strength of Air." The last, by John B. Whitehead, was entitled "Electric Strength of Air." Abstracts of these follow.

### Electric Strength of Air.

This is a continuation of the research on the nature of the breakdown of air under electric stress. The present experiments are in three parts: the first is a study of the character of the ionization emanating from the corona. The corona is formed on a wire at the center of an open mesh cylinder, which is surrounded by an outer closed cylinder of very slightly larger diameter. This outer cylinder takes the place of the small electrode of the earlier experiments and permits the use of a galvanometer as observing instrument. By applying voltages of different values and sign to the outer cylinder the character of the discharge is investigated. The results indicate that the carriers constituting the ionization due to corona are positively charged in the early stages, but that with increasing voltage the negative carriers predominate. Other peculiarities of the ionization arising from the corona are described. The paper shows a number of interesting photographs showing the variation of the diameter of the corona with increasing voltage. These photographs are taken with ordinary glass lenses and also with a quartz-fluorite lens which transmits all the ultra-violet. The results of this portion of the work show that there is no wave-length shorter than 0.00018 millimeter emanating from the visible corona. A set of experiments on

divided conductors is also described. The critical corona voltage of single wires is compared with that of three or more equal circular wires of the same total cross section. The critical voltage may be raised 16 per cent for division into three and 20 per cent for division into four wires. In these arrangements the maximum critical intensity for air is shown to have different values even though obtained at the surface of the same wire.

**Dielectric Strength of Air.**

Mr. Peek's paper is a continuation of the one which he presented at the Institute convention a year ago and embodies results of further investigations of corona formation and loss. The paper can be best summarized by giving some of its conclusions. Among these are: Visual corona starts at a lower voltage if the temperature is increased and also if the barometric pressure is decreased. The disruptive gradient varies directly with the air density. Between 40 and 100 cycles the influence of frequency on the disruptive gradient is small. If the ratio of the distance between the parallel wires to their radius is less than 30, spark-over occurs before the appearance of corona; when this ratio is 30, either spark or corona may occur; when it becomes greater than 30, visible corona appears. The critical voltage is greatly influenced by irregularities, such as dirt, water, oil, etc. The disruptive gradient of air is constant and equals 30 kilovolts per centimeter. As the result of stroboscopic investigations of corona these discharges were observed on wires and needle points both on the negative and positive parts of the wave. The discharge from points always gives the same impression as a stream of water being forced out under pressure from the positive and gathered in at the negative. In the paper are derived many practical corona formulas and the experiments which serve as a basis therefor are fully described.

**Corona Losses.**

The method employed was not unlike the one by Peek, although the introduction of some new details has been made therein which add much valuable data to the tests and possibly permit of greater accuracy in the final results. The secondary of a 300,000-volt, 30-kilowatt, 60-cycle transformer was opened at the grounded neutral and a Rowland dynamometer, calibrated as an ammeter, and one of the elements of an oscillograph were connected in series therewith. As the dynamometer had been calibrated, the effective value of the current wave obtained by means of the oscillograph was accurately known. An auxiliary coil so placed as to link the average flux cutting the secondary coils was connected to a voltmeter and a second oscillograph element in parallel. The middle point of the auxiliary coil was grounded. The ratio of turns on the auxiliary and secondary windings was not depended upon to determine the secondary voltage, but a calibration curve was plotted between auxiliary-coil voltage and secondary voltage as determined by spark-gap measurement under all conditions of transformer loading and line spacing. The ordinate of the oscillograph voltage wave was therefore expressed in terms of secondary voltage between wires, while the current and voltage readings and waves combined enabled the power-factor, power and wave distortion to be determined. As a check, readings in the primary were also taken. The line spacing having been carefully adjusted, the calibration of the auxiliary-coil voltage was determined first with the line and feeders, and secondly with the rack and feeders connected to the transformer. The difference between these two calibration curves, due to the greater leakage flux in the transformer when furnishing the greater charging current demanded by the line, is quite marked and may have introduced errors in other investigations. The corona-loss curves resulting from the tests obey a quadratic law both below and above the visual critical voltage, although the constant is different for the two portions of the curve. Peek's curve below the visual critical voltage was represented by a more complicated equation than the quadratic. A study of the results of other observers indicates that only an occasional curve obeys the quadratic law. For instance, but four of the 29 curves determined by Mershon are quadratic and these four represent tests upon very large stranded cables at comparatively low voltages so that but little of the curve above the critical voltage is available. The corona losses upon the Shoshone-Denver lines were found by Faccioli to obey the quadratic law.

A comparison was made of the results of several tests upon both operating and experimental transmission lines. Mershon's results are considerably lower than the others, while those of this paper check Peek's results fairly well, especially at the higher voltages. Peek's equation gives slightly too low values of loss. The number of tests available does not justify a change in the equation, however.

The discussion was opened by John B. Taylor, who referred to the swinging of the line in Mr. Peek's work. This had a period of one second, on a span 500 feet long, and must have been due to some extraneous influence such as a slow pulsation of voltage on the line. He suggested that the use of the stroboscope, quartz lens, spectroscope, and other instruments should be used in conjunction to get the most complete information.

A. E. Kennelly said that the parabolic law was established, and the problem now was to investigate the scientific points regarding the mechanism of the phenomenon. He referred to the difference between the Ryan and the Peek formulas. Mr. Peek described the appearance of the positive discharge as resembling a flow from wire to air. Is it not as likely a flow from air to wire, consisting of negative ions streaming into the positive conductor?

C. P. Steinmetz stated that the quadratic law is an empirical law, and is probably only an approximation. The two parts found by Professor Harding do not seem reasonable. When elements producing departures from a natural law are steady, they give what is apparently another law, which does not represent the nominal conditions. In the papers of Dr. Whitehead and Mr. Peek we are getting down to the reasons why the laws apply. It is probable that the positive and negative discharges begin at different voltages and represent losses different in amount. They would become automatically equalized, however, by a charge on the line changing the potential with respect to ground. By superposing a direct potential on a line we might be able to change the losses, appreciably. He disagreed with Dr. Whitehead's statement that the free ionization of the air had no part in the phenomenon. There is no evidence to support this. Free ionization might affect the rapidity of formation of corona, but not the voltage. He greatly regretted that the complete data of Mr. Peek's paper had not been printed by the Papers Committee, as it would help to advance our knowledge of corona.

President Dunn explained the considerations which had influenced the committee in restricting the length of the paper.

C. F. Harding explained that the rack losses included connecting wires and it was not practical to reduce them. While the observed losses did not follow the quadratic law, their difference did, which was an indication of the accuracy of the correction. The part of the curve below the critical point is unimportant.

F. W. Peek, Jr., considered Professor Harding's calibration by means of needle points unsatisfactory, and thought his own method superior.

J. B. Whitehead considered Mr. Peek's work with various temperatures very valuable, but thought the results could be expressed by a better formula than that given, which was not entirely borne out by the facts. Work had been done in his laboratory on the variation with pressure. Ryan claimed that natural ionization affected corona, but he had shown that such effect was negligible.

**Artificial Transmission Line.**

A. E. Kennelly then presented a paper by himself and F. W. Lieberknecht entitled "Measurements of Voltage and Current over a Long Artificial Power-Transmission Line at 25 and 60 Cycles per Second."

A transmission line 1,040 kilometers in length was imitated by suitable arrangement of inductance coils and condensers and operated experimentally at 60 and 25 cycles and 100 volts. The results are directly applicable to any single-star branch of a symmetrical three-phase line. Potential and current were measured at various points along the line, an alternating-current potentiometer being used, by means of which both magnitude and phase could be determined. A vibration galvanometer was used as detector. Readings were taken with the line open at the distant end and with both inductive and non-

inductive loads. The readings were found to agree with computations from the known constants according to the hyperbolic-function theory. At 60 cycles the voltage at the open end of the line was 75 per cent greater than at the sending end. At 25 cycles it was 10 per cent higher. The effect of applying the load was to reduce the current at the sending end. A sign-wave generator was used and great care was necessary to keep the frequency constant.

This paper was discussed by P. W. Sothman, C. P. Steinmetz, J. P. Jackson, C. F. Scott, J. B. Whitehead and J. B. Taylor. Dr. Steinmetz said that such close agreement between experiment and theory proved the theory to be correct. Professor Jackson proposed that where data cannot be published in full, they be kept on file in the library for reference.

In closing, Dr. Kennelly stated that the line duplicated a particular transmission line, and referred to the difficulties of keeping the voltage and frequency constant.

The parallel session of Tuesday morning dealt with six papers upon subjects related to electrochemistry. These were: "The Electrolytic Corrosion of Iron in Street Soils," by A. F. Ganz.; "The Electric Furnace," by F. A. J. Fitzgerald: "The Simplification of Electrothermal Calculations; the Watt and Thermal Ohm," by Carl Hering; "Vacua," by W. R. Whitney; "Metallic Tungsten and Some of its Applications," by W. D. Coolidge; "The Convection and Conduction of Heat in Gases," by Irving Langmuir. The chair at this session was occupied by Vice-President Harold W. Buck.

### Electric Lighting Session.

On Wednesday morning a joint session with the Illuminating Engineering Society was held. President Dunn called the meeting to order and then called upon V. R. Lansingh, president of the Illuminating Engineering Society, for an opening address, in which he referred to the origin of the society, its scope and the need for it.

Papers by C. E. Clewell on "Industrial Illumination and Average Performance of Lighting Systems" and by Bassett Jones, Jr., on "Problems of Interior Illumination" were then presented, the latter giving some demonstrations of the effect of position and color of the source of light upon the perception of relief and of color values. The two papers were discussed together.

### Industrial Illumination.

Mr. Clewell's paper opens with a brief consideration of the average size and candlepower range of various types of electric lamps and the influence of height and character of ceiling and roof trusses on the size of lamp to be employed. Among other factors to be taken into account in designing an installation are, the spacing distance to avoid deep shadows, the mounting height to permit of ready accessibility but to avoid glare, the efficiency of utilization, and degree of maintenance. The importance of the latter is emphasized by a series of tests in five different office and factory installations where tungsten lamps and glass reflectors were cleaned at periods ranging from 9 to 17 weeks, all cases showing the desirability of cleaning at more frequent intervals. The slight increase in cleaning cost is made up several times by the saving permissible through the use of the fewer lamps needed to give a certain average illumination. The relatively small proportion of total manufacturing cost due to lighting compared with the item of wages shows that good illumination can be obtained at an almost negligible increase in the total production costs and is bound to have a very decidedly beneficial effect on the workmanship and surroundings.

### Interior Illumination.

In the first part of his paper, Mr. Jones points out that too much stress is laid in many lighting installations on the energy efficiency and not enough on the general efficiency and effectiveness of the lighting equipment and illumination produced thereby. The effectiveness must be determined by taking into account broader considerations, such as harmony with the use of the room and its architectural design as to general treatment, ornament, color and shadow effects. The illuminating engineer must have a full grasp of the possibilities of enhancing the ornamentation by skillful use of color and shadow in the illumination. The author considers indirect lighting to give an unnatural and too emphatic prominence to the ceiling. It also does not permit the eye to rest because there is too great uniformity of illumination. Any design of interior illumination should take into consideration a great many features that are commonly overlooked. Having determined the direction, intensity and character of light that should be provided in various parts of the room, the location of the light sources can then be taken up, and the amount of light flux to be generated finally determined. For the latter three methods are available: the point-by-point method, flux method and absorption method. Mr. Jones discusses these and then takes up a concrete illustration of the principles and methods by a review of the studies and calculations involved in the design of the lighting of a banking room. For this purpose he selects a composite system with indirect illumination of the main ceiling from concealed reflectors on top of the banking screen, semi-indirect pendants in the bays, and special diffuse direct lighting for the working desks and counters.

The discussion was opened by D. McFarlan Moore, who pointed out the necessity of attention to shadow effects. It is not always desirable that artificial light imitate daylight, but in general the more diffuse it is, the more it resembles daylight.

P. S. Millar drew a distinction between efficacy and efficiency of lighting. It is usually expensive to properly light an interior and hence efficiency of the means is very important.

C. F. Scott gave examples of study of the illumination needs in specific cases, and of the opportunities of saving time of wage earners by proper lighting. He pointed out that a less number of lamps were required when they were kept clean.

A. E. Kennelly emphasized the cost of dirt on reflectors to user and producer of light and the distinction between the two.

E. B. Rowe stated that the depreciation of walls and ceilings as well as of uncleaned reflectors, was considerable. In one case he had found it to amount to 10 to 14 per cent in three months. In the experiments of Mr. Clewell the walls were dark, so that this element did not enter.

C. H. Sharp emphasized the value of the data in Clewell's paper. The light needed for any installation is a local problem, the foot-candles necessary depending upon the work to be done. Mr. Jones had shown the same to be true for decorative effects. The data regarding wages show the lack of economy in using anything but the best illumination.

F. C. Caldwell said that the prospective deterioration and the need of allowing for it was often overlooked in the original design. There is a difference in the illumination needed at night and shortly after daylight.

G. H. Stickney said that the two papers emphasize two important problems and two methods of treating them. One problem is that of beautiful effects, the other is of utility versus cost. One treatment is the laboratory method, the other the case method, or a study of individual installations. Depreciation may be inherent or acquired. A lamp has the former. The latter depends upon external conditions and proper maintenance. Practically not enough attention is given to cleaning. When we have such demonstrations of the saving from proper illumination, it is strange that many of the old installations are not superseded. One per cent of the saving will usually pay for the cost of the change.

W. J. Hammer and D. A. Chapman also spoke. Answering a question of the latter, Mr. Clewell stated that daylight lighting of drafting rooms could be duplicated by a semi-indirect installation. He illustrated the fact that localized lighting is seldom necessary by the case of a shop in which 1,200 individual lamps were removed for a month, at the end of which time the replacement of less than 50 was requested.

Bassett Jones, Jr., in closing, stated that imitation of daylight was not desirable, as to either intensity or color. He showed that light from a north sky is blue, and north rooms should have walls tinted to correspond. South

rooms require a buff tint, with part of the wall red.

Louis Bell then presented a paper entitled "Relations of Illuminating Engineering to Electrical Engineering."

### Relation of Illuminating Engineering to Electrical Engineering.

Illumination calculations antedate electrical engineering. Optical laws and the use of the photometer were well known prior to electrical developments. Even the searchlight was in use, based on the calcium light. Indirect lighting had been used indoors and the tower system outdoors. Principles and details were old, but the advent of the electric lamp brought technical developments. Many of the problems in illumination by gas or oil are chemical, and illuminating problems generally reach beyond the mathematical and physical to the and invade the borderland of physiology and psychology. It is interlocked with the other sciences and the literature of the subject is widely scattered. But illuminating engineering is most closely in touch with electrical engineering and must look to it for advancement. He referred to the convenience of the incandescent lamp, which had stimulated the invention of the gas mantle, and this in turn had led to the invention of the metal-filament lamp. A comparison of lumens per watt with ten years ago involves more than a gain in efficiency of the lamp, but in the appurtenances also. The electrical engineer has supplied better means; the illuminating engineer has applied them. He still wants a lamp of high efficiency and low intrinsic brilliancy. The latter is necessary for usefulness, and efficiency must be sacrificed in its absence by cutting down the light. The latest advances in efficiency have been through utilization of higher temperatures and are therefore wrong. An efficient lamp giving monochromatic light of any color is also greatly desired. There is a call in the arts for artificial daylight. A third demand upon the electrical engineer is for a unit of high efficiency and low candlepower. The electric lamp is displacing all others, gas and oil being relegated to the production of heat. It is made universally applicable by the transmission of electric power.

Herbert E. Ives closed the session with a demonstration of some of the relations of color to illumination work. He showed some colored lantern slides of various types of spectra and gave a demonstration of matching colors by three-color mixture. He also showed three white lights of different spectral composition, one a continuous spectrum, one a combination of red with blue-green, and one a combination of yellow with blue. The last two were shown to be deficient for color matching.

### Railway Session.

At the close of the Lighting Session a Railway Session was held, devoted to a discussion of the paper presented by Samuel Insull at the New York meeting on April 5 and abstracted in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for April 13, 1912.

This paper advocated the centralization of electric-power generation for all purposes, including electric railways and electrified steam railroads, and showed that electrification would be more feasible under such conditions of power supply.

The discussion was continued on Thursday after the close of the session devoted to papers on telephony and telegraphy.

Frank J. Sprague opened the discussion, stating that a system should be chosen to suit the best operation of the railroad to be electrified. He referred to the unique conditions in Chicago, where a Smoke Abatement Committee is studying the problem, and where it is necessary for 32 railroads to agree upon a common system. The power for each of these is pitifully small when compared to a single modern generating unit, and group supply consequently offers a natural solution. Centralized supply offers an even greater economy of investment and operation. The preliminary report of the Chicago committee indicates that there will be much delay, and a third party should enter the problem with a financial offer which would limit the needs of the railroads for additional capital to make the change. He resented the criticism which Mr. Insull had made of the New York Central power houses. Insurance of supply and ample power were the prime requisites. They had offered to supply the New Haven road, but the latter had unwisely built its own power houses. He had investigated the cost of power at the different power houses and substations for 1911 and found that five of them averaged 0.51 cents per kilowatt-hour at the switchboard, the lowest being 0.45 cents for Port Morris and Marion. At Cos Cob the cost is 45 to 60 per cent higher and very variable.

H. G. Stott thought that Mr. Insull's conclusions were based upon conditions in Chicago and were not generally applicable. The plants which had been abandoned there were ready for reconstruction and there was little if any loss in abandoning them, whereas, the Commonwealth Edison Company had the most modern equipment. This made a difference of perhaps 20 per cent, and the figures were not applicable elsewhere. He had studied the effect of load-factor upon cost and found the cost inversely proportional to the square root of the load-factor. Applying this to a case given by Mr. Insull in New York City the saving would be 2.5 per cent or $125,000 instead of $1,000,000. The latter value must have been based upon Chicago conditions and not upon general conditions. There is little gain in cost after units reach 10,000 kilowatts, and in railway work the peaks all come together, there being no diversity in the load. Hence there is no advantage in a common station. A reserve of 10 per cent is enough in railway work, whereas Mr. Insull had put it at 50 per cent for a single plant and 25 per cent for a combined plant. Regarding cost of copper, the cross-section is the same regardless of source of power, and length depends upon the center of generation. Localized supply is cheapest on this score. If a generating station is abandoned, its amortization must be considered, and unless the cost of power is low enough to cover this, there is no gain.

William McClellan said that the cost question limits electrification to a few roads, but why was it not adopted on these? Little further was to be expected in lessening the cost of either the third-rail or the catenary construction, so why delay? Can the capital cost for power be reduced? He agreed with Mr. Stott regarding localized supply and the sharing of profits to cover amortization.

Calvert Townley said that generation was linked to distribution, and to imagine all the country's power generated in one station showed the absurdity of carrying centralization too far. There was a limit to the economical size of a station, unless the power were used locally. Saving from diversity-factor decreases as size increases. The problem is to determine in each case the number of power stations needed. The New Haven road had tried to buy power but the lowest offer was 2.5 cents per kilowatt-hour, so that it had been compelled to build a power house. The load-factor is low, which makes the unit cost high. This will be improved with the eventual load.

W. S. Lee considered the best arrangement to have distributed stations of economic size interconnected. They could then relieve one another on the peak.

P. H. Thomas, W. G. Carlton, N. W. Storer, S. D. Sprong and others also joined in the discussion.

### Meeting of Delegates.

The section delegates met together at luncheon several times during the convention and on Wednesday evening had a formal meeting presided over by P. M. Lincoln, chairman of the Sections Committee.

The first subject discussed was cooperation with other societies, and the experiences of the various sections were related by George W. Lamke, of St. Louis; F. D. Weber, of Portland; C. L. de Muralt, Ann Arbor; J. D. Ross, of Seattle; R. W. Sorensen, of Los Angeles; F. A. Vaughn, of Milwaukee; H. H. Norris, of Ithaca; O.

S. More, of Indianapolis; J. N. Cadby, of Madison; S. B. Charters, Jr., of San Francisco; E. E. Boyer, of Lynn; R. H. Rice, of Chicago, and George E. Kirk, of Toledo. Ralph W. Pope also spoke on the subject.

Upon request, Ralph D. Mershon told of the activities of the Patent Committee and the action that had been taken to oppose the Oldfield bill. He favored the establishment of a committee to study the whole question of patent legislation.

C. P. Steinmetz was called upon to present a proposal which had for its object the giving of greater influence to sections in Institute matters and would make the St. Louis scheme for geographical representation on the Board of Directors unnecessary. The Board has two functions: (1) administrative and executive, (2) determination of questions of policy. The first requires that members attend meetings and practically requires accessibility to New York. The second function does not require quick action, and could be modified by giving the sections a voice through the medium of the initiative and referendum. A referendum on questions of policy coming before the Board of Directors could be extended to the Sections, and any section could be free to bring any matter before the Board on its own initiative. Nominations for officers could also be made by the sections.

Ralph W. Pope, H. G. Stott and Gano Dunn spoke on the subject of nominations, and any change in the present constitutional provisions was shown to be undesirable.

S. B. Charters, Jr., presented a resolution for the appointment by the Board of Directors of a committee to draw up a by-law giving the sections larger duties and responsibilities and greater participation in the conduct of Institute affairs. After much discussion, and the defeat of a substitute resolution, the original resolution was carried.

A. M. Schoen made a motion recommending that the Board of Directors present some appropriate testimonial to future past-presidents, and after debate this was carried.

A motion recommending the reduction of dues was defeated.

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During the convention a joint meeting of the Standards Committee and the United States National Committee of the International Electrotechnical Commission was held. C. O. Mailloux, president of the United States Committee, made a verbal report of the meeting of the Committee on Rating, which he had attended abroad. Communications were received on the subject of "Symbols" from the National subcommittees, and a discussion was had as to the symbols which the United States members of the Commission will advocate. It was made evident that the International subcommittees are doing good work in furthering the aims of the Commission.

A meeting of the Committee on Organization of the International Electrical Congress, to be held in San Francisco, Cal., in 1915, was also held during the convention, and empowered the Executive Committee to make the necessary preparations for the Congress. It is expected that distinguished foreign electrical engineers will be invited to serve upon an Honorary Committee of Organization. In order to effectively organize the work of the various sections, the American section officers will be appointed in advance, and at the time honorary section officers will also be appointed. It is expected that there will be twelve sections dealing with different branches of the subject, in which practical papers and those dealing with both theory and practice will make up the programs. It is intended to discourage papers dealing entirely with theoretical aspects of engineering. In due course of time prominent engineers will be invited to prepare papers for presentation at the Congress and a majority of these will come from abroad.

**Educational Session.**

On Thursday morning a joint meeting was held with the Society for the Promotion of Engineering Education. President Dunn occupied the chair and called upon J. P. Jackson, who opened a symposium on the subject by presenting the report of the Educational Committee, which dealt with industrial education. The committee's work was not confined to electrical engineering, but was made to cover educational conditions as applied to all industries. A special study was made of certain schools of the New England and Middle States and the work divided up as represented by the papers which were to be presented at this session. The speaker divided industrial schools into three classes; (1) those maintained at public expense and open to all children; (2) those privately maintained and open to all children; (3) those maintained by corporations for preparing employees for their own purposes. A distinction was also made between full-time schools and continuation schools. The latter were considered the best suited to conditions usually met. The legal provisions applying in the various states to vocational schools were considered, and an outline given of what each state is doing in this direction. The report closed with a description of certain typical industrial and vocational schools.

Henry H. Norris spoke on "A Few Successful Types of Vocational or Industrial Education in the New England and Middle States and Railroad Schools."

Walter I. Slichter then read a paper entitled "The Important Features of State Laws Relating to Publicly Supported and Controlled Vocational or Industrial Schools."

An interesting discussion followed the presentation of these reports. A. L. Rohrer described the industrial schools at Bridgeport, where the spending of two years of apprenticeship in school is optional.

A. L. Williston emphasized the human losses as compared with the loss of material efficiency when the right boy does not get into the right place. He also described the part-time public schools in Fitchburg.

W. H. L. Hale described the apprentice school of the Pennsylvania Railroad, which is maintained at Altoona, Pa. In this school over 250 apprentices spend one-half day each week in a specially prepared building under three instructors, who are giving there a curriculum consisting largely of practical drawing, English, natural science and mathematics.

W. S. Franklin emphasized the present detachment of the schools from the manufacturing establishments. He thought the latter could be largely used to promote educational work.

William McClellan pointed out that vocational schools are now carried on mainly from the standpoint of the manufacturer, with the idea of supplying him with men properly trained for his work. Every boy should go to some kind of a vocational school and the school should be managed with the idea of the development of the boy rather than of meeting the need of the manufacturer.

H. G. Stott told how the Interborough Rapid Transit Company had been forced to establish a school for vocational training in order to get operators who could properly handle its power house and be dependable in times of emergency.

**Telegraphy and Telephony Session.**

A parallel session was held on Thursday morning at which papers were presented by H. J. W. Fay on "History and Development of Submarine Signaling;" by Fred L. Rhodes on "The Wiring of Large Buildings for Telephone Service;" by Charles F. Meyer and J. B. Whitehead on "The Vibrations of Telephone Diaphragms;" and by George R. Guild on "Military Telegraph Lines Using the Polarized Sounder as Receiving Instrument." Ab-

stracts of these papers will be given next week.

### Electrical Measurements.

On Friday, parallel sessions both morning and afternoon were held for electrical measurements and for industrial power. The session for electrical measurements was opened by President Dunn who called upon Lewis T. Robinson to occupy the chair. The first paper was by Carl Hering and was entitled "Measuring Stray Currents in Underground Pipes."

### Measuring Stray Currents in Underground Pipes.

The paper gives descriptions of methods which were devised so as to be positive and free from any assumptions; they are applicable in general to circuits which cannot be cut, hence include busbars, etc. The fundamental principle is to draw the current out of the conductor locally, by means of a shunt circuit containing a battery and resistance, the latter being adjusted until a millivoltmeter, connected to the conductor, shows that no current is left in it. This shunt circuit, which is then the whole unknown current, is then measured with an ammeter. By then opening this shunt circuit and reading the millivoltmeter, the latter may be calibrated to read thereafter in amperes directly. In practice numerous difficulties arise, notably due to the unsteadiness of the current. To meet these, various modifications of this principle are described. In some the two readings are taken simultaneously instead of successively. From the data obtained the actual resistance of the conductor may be determined without any assumptions. The current entering or leaving a pipe between two stations, is then equal to the difference between the readings at those stations, this being permissible when the measurements are positive, accurate and reliable. A method is also described for identifying the source of these stray currents. It consists in taking voltage drops simultaneously over the pipe, and over the supposedly offending track, taking readings chiefly at the peaks and troughs of the variations, then plotting them; a coincidence of the peaks and troughs of these curves will then show that this track was the source.

The discussion was opened by Albert F. Ganz, who described a method used by himself which was almost identical with that given by the author. Measurement of resistance is only necessary in exceptional cases. It is usually quite sufficient to measure the voltage drop in a section of pipe and estimate the resistance from the dimensions. In determining the current which leaves a pipe from readings at two places, accuracy is necessary and it is best to get 24-hour records at both points. He had also used the method given to identify the source. While the Haber earth ammeter is not satisfactory for measuring the total current leaving a pipe, it is useful for qualitative tests.

George F. Sever spoke of the legal aspect of the question. If a joint test shows current, it is difficult for the railway company to maintain that there is no damage.

E. B. Rosa stated that the Bureau of Standards had tried Hering's method, but did not find it necessary to know the resistance accurately. Different pipes vary but little and a resistance table can be prepared for all sizes. It is then only necessary to measure the voltage drop.

Alexander Maxwell did not think that the author had done justice to Haber's earth ammeter, which will indicate the escape of currents smaller than those which can be detected by other methods.

Frank Wenner referred to the work of Professor Thomas 15 years previously, who had used the author's methods for both current and resistance. He called attention to the danger of thermal electromotive forces in the circuit of the millivoltmeter, as one degree difference in temperature of the contacts with the iron pipe would give 15 microvolts.

E. F. Northrup presented written discussion and C. H. Sharp spoke in appreciation of the paper. Dr. Hering then closed the discussion.

The next paper was by P. G. Agnew and was entitled "A Tubular Electrodynamometer for Heavy Currents." In the absence of the author it was presented by J. R. Craighead. M. G. Newman then presented his paper on "Measurements of Alternating Current of Low Value." This was followed by a paper by Edwin F. Northrup entitled "To Measure an Alternating-Current Resistance, and Compare It with the Direct-Current Resistance." George F. Sever presented this paper, as the author was not present. The three papers were discussed together.

### A Tubular Electrodynamometer for Heavy Currents.

The field "coil" of the instrument consists merely of two coaxial copper tubes, giving a circular field between the tubes. There is no field in this space due to the outer tube, and that due to the inner tube is independent of the skin effect if there is axial symmetry. There are two moving coils astatically placed between the tubes, one on either side of the inner tube, and suspended by a phosphor-bronze strip. The common axis of the tubes is placed in a horizontal position in order to allow the vertical suspension. While the distribution is not the same on alternating as on direct current, the magnetic field in the space between the tubes, and hence the torque, is the same. The inner tube can be centered electrically. For cooling, it is arranged so that water may be passed through the inner tube. The instrument was designed to carry 5,000 amperes. Magnetic impurities on the moving coils were very troublesome but special silver coils were finally wound for the purpose by the Weston Electrical Instrument Company, which were found to be actually diamagnetic.

### Measuring Alternating Current of Low Value.

The sensibility of an ammeter of the dynamometer type can be greatly increased by using an auxiliary current in the field coils, which also greatly reduces the impedance in the test circuit. A phase-shifting transformer is used to obtain the proper phase, which is evidenced by a maximum reading. However if the wave form of current be not the same, the instrument will not properly record the components of current represented by the harmonics. Hence for the exciting current of a coil used to magnetize iron, and in similar cases of distorted wave, large errors might result in this method. Typical examples are given. For flux densities below 6,000 gausses, the error in measurement of exciting current is not large.

### Measuring an Alternating-Current and Direct-Current Resistance.

The alternating-current resistance of a portion of a circuit is defined as: "A quantity which expressed in ohms and multiplied by the square root of the mean square value of the alternating current through the circuit, expressed in amperes, will give the square root of the mean square value of that component of the impressed electromotive-force expressed in volts, which is in phase with the current. Or it is the quantity which, when multiplied by the mean square value of the current, will give the power in watts which is being dissipated in the circuit." This quantity in circuits which contain iron, as steel-cored conductors, will in general differ from and be greater than the value of the resistance which would be obtained using direct currents for the measurement. The alternating-current resistance may be measured by means of an electrodynamometer and directly compared with a direct-current resistance, if the electrodynamometer is provided with a moving system which is astatic in respect to the earth's field. The method of doing this is fully described and the complete theory of the method is given. Certain small corrections are considered and the circumstances given under which these small corrections either disappear or become so small as to be negligible. An experimental test of the method is recorded and data obtained experimentally are compared with the predictions of theory, the comparison being favorable. The character of the paper is such as not to admit of a clear exposition in a brief abstract. It may be stated, however, that while it is independent of any instrumental constant it is a deflection method and, therefore, is, to a certain extent, dependent upon the current remaining steady for a very brief instant. A three-point double-throw switch, when thrown to one position, enables the watts in a coil, A, under test, to be compared, when the switch is thrown in another position, with the watts expended in a variable resistance r, which is assumed to be the same for both direct and alternating current. The circuits are so arranged, that when the switch is thrown from one position to the other, the current through the fixed coils of the electrodynamometer is not altered. The adjustment which is required for making the measurement consists in varying the ohmic resistance r, until the de-

flection of the electrodynamometer remains unchanged when the switch is thrown quickly from one position to the other, and vice versa. The method is thought to have value for measuring the alternating-current resistance of steel-cored conductors, or iron conductors of any kind. The theoretical treatment is sufficiently complete to enable the electrodynamometer to be correctly used under a number of circumstances including, especially, the case considered.

W. H. Pratt referred to a water-cooled dynamometer which carried 2,000 amperes, which he had used several years ago. This was accurate to 0.1 per cent. Stranding prevents eddy currents.

John D. Ball referred to the use of a portable wattmeter with separately excited field coils as an ammeter. This is more sensitive and has a better scale than the ordinary ammeter.

M. G. Lloyd referred to the thermo-ammeter for small currents. In using the separately excited ammeter for distorted waves, a current of similar wave form could be obtained in the field by passing it through the magnetizing coil of a bundle of iron of the same quality, magnetized to the same flux-density.

A. L. Ellis spoke of the necessity, in water-cooled instruments, of preventing iron rust from lodging in the water pipes.

E. B. Rosa called attention to the great advantage of Dr. Agnew's instrument in the lack of any external stray field.

These papers were also discussed by C. W. Sharp, Frank Wenner, Taylor Reed and L. T. Robinson.

The next paper to be presented was by Evan J. Edwards and was entitled "Electrical Measurements with Special Reference to Lamp Testing."

### Electrical Measurements for Lamp Testing.

In this paper the author first calls attention to the need of high electrical accuracy in photometric and lamp-testing laboratories. The change in luminous intensity for one per cent change in pressure for carbon and tungsten lamps is given as 5.7 per cent and 3.7 per cent respectively. Attention is called to the fact that test life of incandescent lamps is much affected by changes in voltage. A criterion of 0.1 per cent is given as the desired accuracy in electrical measurements for photometric and lamp-testing laboratories. Then follows a description of the methods used in the Engineering Department of the National Electric Lamp Association for insuring the desired accuracy. Some very interesting curves are given of an analysis of the accuracy in meter reading, dividing the subjective errors into two classes: one, the directional errors due to the subject's misconception as to where the tenth points between smallest divisions lie; the other, the so-called unavoidable errors. The average observer reads the lower tenth too high by the same amount as the upper ones too low. After a detailed description of a method for a complete test of an electrical instrument, with a sample graphical report, the author concludes by describing a special indicating voltmeter used on life-test racks. This voltmeter has a scale which can be shifted in order to make the reading correction zero. In addition to this, it is provided with a second scale, which shows the position to which the main scale has been shifted, in order that a complete record of the adjustment of the instrument from time to time can be made.

This and the following paper by T. H. Amrine were discussed together. The latter was entitled "Incandescent Lamps as Resistances."

### Incandescent Lamps as Resistors.

This paper emphasizes the value of incandescent lamps as resistances and gives such information regarding characteristics, ranges of resistance and current-carrying capacity available as will enable one to choose the proper lamps for any particular purpose. Curves between per-cent normal current and per-cent of cold resistance for all the filament materials in commercial use and for a few forms of treated carbon that are not commercial are given. These show that over limited ranges almost any desired change in resistance with change in current can be obtained, ranging from a pronounced decrease to a very large increase, as well as a practically negligible change of resistance with current. A table of exponents is also given that enables one to determine the change in resistance corresponding to any change in current, volts, watts, candlepower or efficiency. An outline of the method of selection of the proper resistor lamps for any purpose is given and some examples of uses to which they have been put other than the familiar laboratory use in lamp banks, etc., are noted. The use of standard-lamp resistors for checking ammeters, and of the four-lamp bridge as voltage, current and temperature indicator is mentioned in this connection.

The discussion was opened by Clayton H. Sharp, who stated that voltmeter corrections must be very carefully determined for life testing. High accuracy is necessary as 0.1 per cent in voltage makes a difference of several per cent in life. This condition is not sufficiently emphasized. In his work, a static voltmeter reading by mirror and scale is used to check the test instrument before and after each measurement. He regarded Mr. Amrine's arrangement as a modification of the old Howell indicator. This is very sensitive to small changes in high voltage, when carbon and tungsten lamps are used in the respective arms of the bridge. With the photometer he considered it desirable to use two potentiometers.

A. E. Kennelly said that no one instrument should be taken as a final standard and told of the satisfaction he had with the alternating-current potentiometer, which is accurate to 0.05 per cent.

Paul MacGahan described a device for limiting the spark on lamp circuits.

After questions by M. G. Lloyd the authors then closed the discussion.

The next paper, by O. J. Bliss, entitled "Electrical Transmission of Electrical Measurements" was then presented, in the absence of the author, by W. A. Durgin. This and the three following papers were discussed together. The other papers were: "Metering Large Direct-Current Installations," by F. V. Magalhaes; "Measurement of Energy with Instrument Transformers," by Alexander Maxwell; "Wheatstone-Bridge-Rotating-Standard Method of Testing Large-Capacity Watt-hour Meters," by C. H. Ingalls and J. W. Cowles. The last paper was presented by Mr. Ingalls.

### Electrical Transmission of Measurements.

The paper by Mr. Bliss describes a unique arrangement of standard instruments for the purpose of reproducing at a distance of 35 miles measurements of indicated kilowatt input to a 12,000-volt, 60-cycle, three-phase power line. It was desired to have a check at the receiving end of this line, on the recording and graphic indicating wattmeters located at the power house. A telephone line was loaned as a partly private line for this purpose. At the receiving end two direct-currnt voltmeters were connected in series, one being an indicating instrument and the other a curve-drawing device. These were connected through reactance coils across the telephone line. At the power house a local circuit containing a 36-volt storage battery and rheostat were similarly connected through a variable contact on the rheostat. This contact was continually shifted by means of the recording mechanism of the graphic wattmeter on the switchboard. The direct current impressed on the telephone line and distant voltmeters was, therefore, made directly proportional to the power input as read on this wattmeter. This use of the telephone line did not interfere with its regular telephonic use. To prevent the direct current from interfering with the telephonic current, condensers were inserted immediately beyond the generating and receiving stations along this special telephone line and also at intervening taps. The use of the reactance coils in the bridges at the generating and receiving stations kept out the telephone ringing current. The system operated with complete satisfaction and seems to indicate the possibility of using similar equipment for recording various electrical measurements at long distance.

### Metering Large Direct-Current Installations.

Four methods of metering direct currents of 1,000 to 10,000 amperes on circuits up to 600 volts were considered: (1) a single watt-hour meter between source and distributing switchboard; (2) several watt-hour meters in parallel; (3) meter separately the different parts of the load beyond the main switchboard; (4) use a shunt type of watt-hour meter. Method (1) is the most easily and cheaply installed, the most difficult and expensive to maintain and probably less accurate. The dis-

advantages are the possibility of complete interruption of registration, difficulty of testing and expense of calibrating standards. Method (2) increases the initial meter cost, but testing is simplified and in case of defect in a meter only part of the registration is affected. It has the same disadvantage of poor performance on light loads. Method (3) is best for most conditions, as each meter may be suited to the size of its load and performance will be better than in methods (1) and (2). The development of a totalizing dial would provide a record of the total registration of the various meters. Method (4) would have several advantages if such a type were available. It would be possible to meter a large installation with a single meter, which could be compared quickly and accurately with a rotating standard. It would present great flexibility, since the meters could all be of 5 or 10 amperes capacity and large ranges obtained by a stock of shunts.

**Measurement of Energy with Instrument Transformers.**

Instrument transformers in which ratio and phase angle differ from ideal conditions will cause errors in electrical measurements which are of special importance in connection with energy meters. This is on account of the fact that such meters cannot be automatically compensated for these errors, and the measurements cannot be corrected by computation. Errors due to the characteristics of instrument transformers are generally more troublesome in current transformers, and less troublesome in potential transformers, for constant-potential circuits. It is possible to compensate for transformer ratio by manipulating the light load adjustments of meters, owing to the fact that the meter calibration curve may be caused to be practically identical in form with the ratio curve of a current transformer. Errors produced by a difference in phase between the primary and secondary currents of a transformer cannot be conveniently compensated in the meter, but it is shown that small differences in phase produce comparatively small errors of measurement over a wide range of circuit power-factor, whereas the magnitude of the error increases rapidly with the phase difference. The paper states that good commercial transformers, when lightly loaded, show variations in ratio which can be easily compensated by the method suggested above, and that in such transformers the errors due to phase angle are reasonably small if the transformer is lightly loaded. For the foregoing reasons, the best accuracy is attained with energy meters where the transformers employing them are very lightly loaded, preferably supplying the meter circuits alone.

**Wheatstone Bridge—Rotating Standard Method of Testing Large Capacity Watt-Hour Meters.**

Where large-capacity direct-current meters are to be tested, the problem is somewhat difficult. The method usually chosen is the indicating instrument—stopwatch method, by which method the energy delivered to the meter under test is measured by indicating instruments (voltmeter, millivoltmeter and shunt) and the speed of the meter determined by a stopwatch. Where the load is constant, this method is satisfactory, but for power circuits similar to street railways, where there are rapid fluctuations of considerable magnitude, this method is not desirable.

The rotating standard has many advantages when used on loads of this character, but unfortunately they are not made commercially of a capacity exceeding 150 amperes, and unlike millivoltmeters, it is not advisable to use them directly with shunts with the possible exception of the mercury flotation type.

In order to adapt the rotating standard to the testing of meters of 1,000 or 2,000 amperes capacity, a differential galvanometer was devised by F. A. Laws, of the Massachusetts Institute of Technology, which was so arranged that a standard of moderate capacity could be used. It consisted essentially of two current coils wound in opposition having between them a pivoted coil of fine wire. One coil is of few turns (actually a straight copper bar) but of sufficient capacity to carry the full line current. The second coil has the same current capacity as the rotating standard and with the proper number of turns, so that by adjusting a resistance the currents will balance each other.

With this condition of balance, which is indicated by a pointer, the ratio of the two currents is a constant, and the rotating standard will measure a definite percentage of the total energy delivered to the meter under test. This ratio and percentage is determined in the laboratory by actual measurements. The differential galvanometer as described above is subject to the influence of external fields and a modification of this method was devised by the writer based on the general principle of a wheatstone bridge.

In using the direct-current rotating standard, care should be exercised to guard against the influence of external fields and since this apparatus is designed for use in places where large currents are involved, precaution should be taken either to take two series of readings, one series to be with both the current and potential leads of the rotating standard reversed or bodily changing the position of the standard 180° and taking a series of readings in both azimuths. In either case the average of the two series should be used.

The discussion was opened by W. J. Mowbray, who claimed to have invented the rotating standard.

F. E. Foss considered the third method of Mr. Magalhaes the most accurate and therefore worth the extra cost. It is a problem to get a totalizing dial which will work when the impulses come simultaneously.

J. R. Craighead, discussing Mr. Bliss's paper, stated that another way of getting a record at a distance is by a special design of current transformer giving 0.5 ampere in the secondary. This can be of the same design as a five-ampere transformer, but the line drop is not so limited and the line resistance can be 100 times as great. One objection to this is that there must be a large number of turns in the secondary and the open-circuit voltage is consequently high. Referring to Mr. Maxwell's paper, he thought that a light-load adjustment would increase the percentage of meters showing creeping and the method was not advisable unless there was frequent inspection.

Others who joined in the discussion were Messrs. Varley, W. H. Pratt, and L. T. Robinson, and the authors then closed.

H. G. Stott then presented a paper entitled "The Myrowatt," which had been perpared by himself and Haylett O'Neill. This paper proposed the introduction of a new unit of power equal to 10 kilowatts and representing approximately the same amount of power as is represented in heating units by a boiler horsepower. He emphasized the difference between the values used for a horsepower in different countries and the entire lack of connection between these amounts of power and that represented by a boiler horsepower. Simplicity would be attained by abandoning these units and expressing all power in the form of heat in terms of either the kilowatt or the new unit. Computation of efficiency of direct-connected units, and of all engines transforming heat energy into mechanical energy would then be much simplified. Examples were given to illustrate these points.

These suggestions were approved by Carl Hering and A. E. Kennelly, the latter suggesting that the name "myriawatt," already in use, was preferable to the new term.

M. G. Lloyd called attention to the fact that the horsepower is usually defined as a variable quantity, as is noted in the Standardization Rules of the Institute. If the horsepower is to be retained as a unit, the definition should be altered so as to make it a definite quantity, not only by recommendation in the Standardization Rules but by legal enactment.

The next paper, "Characteristics and Applications of Vibration Galvanometers," was presented by Frank Wenner.

**Vibration Galvanometer.**

A mathematical study of the vibration galvanometer is given, considering it as a type of synchronous motor. It is pointed out that its characteristics are like those of this type of motor and entirely different from the ordinary type of galvanometer. Several different forms of vibration galvanometer are described. The instrument is now little used in engineering work but will find greater application when it becomes more widely known and its ruggedness appreciated. The instrument can be tuned to a definite frequency and is then sensitive only to currents of this frequency. It can be used quantitatively but is more useful as a detector in null methods of measurement. Adjustment for different frequencies is made by varying the length

or tension of the suspension. Its applications in various forms of measuring apparatus at the Bureau of Standards and the National Physical Laboratory in England are listed.

The discussion took the form of questions by Messrs. Pratt, Craighead, Ganz, Hopkins, Ball and Lloyd. After the author had answered these the session adjourned.

The afternoon session opened with a paper by Paul MacGahan entitled "Induction-Type Indicating Instruments." This and the three following papers were discussed together. These were by A. L. Ellis on "Compensating Wattmeters"; by A. W. Pierce and M. E. Tressler on "Hot-Wire Instruments"; and by W. H. Pratt and D. R Price on "Resonant-Circuit Frequency Indicator."

**Induction Indicating Meters.**

The modern requirements for switchboard meters are stated to have changed from those existing previously, due to the fact that modern generating equipment is of greater capacity, operating at higher voltages and higher currents, and at more nearly constant frequency. Thus there has resulted a readjustment of the relative values of the different kinds of electrical errors to which switchboard meters may be subject. Freedom from external static or magnetic fields is thus of greater importance and freedom from frequency errors of lesser importance than originally. Moreover, a compact arrangement of a switchboard is considered important on account of the cost of space in large cities, location in operating galleries and visibility of each instrument from the point of control. In addition to this the questions of readability, aperiodicity, ruggedness and simplicity are becoming more important, the two latter qualities due to the tendency of central stations to maintain their own repair departments, rather than rely upon the manufacturers for repairs or readjustments. It is pointed out that for alternating-current meters the induction-type instruments with the long scales that are inherent to this type offer great advantages in meeting modern conditions as outlined above. The three principles of operation found commercially today in alternating-current meters are the moving-iron electromagnetic type, the moving-coil electrodynamometer type and the induction type. The relative advantages of these are enumerated. It is pointed out that the moving-coil or moving-iron meters as now manufactured represent nearly the highest state of development to which these types can be brought, whereas the newer induction type, which is not subject to the inherent limitations of the other two types, can be expected to be further improved in the future, the writer being of the opinion that it will eventually supersede the other types for switchboard work for the same reasons that this principle has superseded all others in the case of alternating-current watt-hour meters. A portion of the paper is devoted to tabulated data as to compactness and readability of various types, and considerable space is devoted to a new treatment of the theory of the induction indicating meters. Pre-eminence is given to the induction-type construction in a seven-inch case.

**Compensating Wattmeters.**

This paper points out the necessity for a suitable instrument for measuring small amounts of electrical energy delivered to various devices at a known voltage, and calls attention to the shortcomings of the compensated wattmeter as ordinarily constructed. Seven prime requisites are given for such an instrument, foremost of which is that its errors can be readily computed for all conditions of load, power-factor scale position, etc., and readings corrected for these errors. Several methods of obtaining compensation are mentioned. As commonly constructed, the compensation can be correct for one scale position only because of the series and compensating windings. Curves are given showing the deficiency in compensation, amounting to 6 per cent for the common type as contrasted with 0.2 per cent for a special type having coils wound with due regard to first principles. A table giving the observed errors due to incorrect compensation for several conditions of load, show them to be in excellent agreement with errors to be expected and within the limits of error of observation for the special instrument. The observed errors in the common type are much larger and not in good agreement with the calculated errors. The special instrument is provided with a second compensating coil to correct wattmeter indications for loss in a voltmeter connected in parallel with it; corrections for losses in potential circuit of wattemter and in voltmeter can be made with equal facility. The wattmeter is not affected by the mutual inductance due to the load current, but the voltmeter is seriously affected. Attention is called to the necessitv for a large current capacity in terms of full-scale watts and a change in the rating of the potential circuit in order to obtain a more readable deflection on low power-factor. It is pointed out that it is desirable from a mechanical standpoint to use metal to definitely locate the various vital parts and that comparatively large amounts of metal can be used without a noticeable error due to eddy currents, if properly located.

**Hot-Wire Instruments.**

Hot-wire instruments have a field between the ranges of pivoted instruments of the dynamometer or iron-vane type and sensitive reflecting instruments. Three-volt instruments are available with zero temperature coefficient and small inductance, giving accuracy up to 500 cycles. Ammeters are available with full-scale reading of 0.25. Up to 6 amperes no shunt is needed and the instrument is independent of wave form, frequency and stray fields. The voltage drop and power consumption compare favorably with moving-iron ammeters. Good constancy of calibration is found. With shunts the range can be extended to 2,000 amperes, but this consumes more power than a transformer and moving-wire instrument. It has advantages in calibration, however. No other type is so well suited for high-frequency work.

**Frequency Indicator.**

This instrument is of the dynamometer type, and is independent of wave form, voltage and temperature. There are two moving coils fastened rigidly together at right angles, and each is in series with a circuit made up of resistance, reactance and a condenser. One of these is adjusted for resonance at 70 cycles, the other at 58 cycles. A third circuit in parallel with the latter is adjusted for 36 cycles. The field coil carries the current of both moving coils as it is connected in series before the circuit divides. The instrument has a range from 55 to 65 cycles with a six-inch scale. It is possible to get the same movement for a change in frequency of one cycle. The construction of the instrument is described. The inductances have laminated iron cores with an air gap and the flux is kept low.

The discussion was opened by F. P. Cox, who agreed that for low voltage and high frequency hot-wire instruments were suitable, but not for other conditions. In using them at high frequency an air transformer is superior to a shunt. The induction type of instrument is valuable for certain conditions but has decided limitations. The long scale is an advantage generally, but when the error of the instrument is greater than the limit of reading, it is of no advantage. A light moving element is not necessarily weak, but the average meter man cannot handle it. Shielding is essential in instruments affected by external fields. A black scale with white figures is superior in certain cases, but not everywhere. It is not desirable to have the scale open at the top, as switchboard instruments are usually used at lower readings, since they have overload capacity.

W. H. Pratt, referring to induction instruments, said that the voltmeter and wattmeter are of equal importance with the ammeter, but they are not so easily made accurate. He preferred a moving element of light weight.

A. F. Ganz favored a light-weight movement on account of both jewel wear and damping.

W. J. Mowbray stated that with low illumination it is better to have white figures on a black ground.

A. L. Ellis pointed out how the rolling of a steel pivot on a horizontal jewel would produce scale errors. He questioned the figures given for jewel load by Mr. MacGahan

P. M. Lincoln told of trying the same scheme for a frequency meter some years ago, but he had later adopted a better one. Since the power-factor changes rapidly at resonance, a power-factor meter also makes a good frequency meter.

E. J. Bowen thought that the popularity of the first hot-wire instruments had been due to their foreign finish and their interchangeability between alternating and direct current. He thought most users of the instruments were less skillful than Mr. Pierce and would condemn them because they did not get the same accuracy.

N. M. Hopkins and F. V. Magalhaes also spoke.

In closing, Mr. MacGahan told how the ammeter was compensated for temperature. It includes a series transformer with a short-circuited secondary whose increase of resistance with temperature increases the magnetic flux. This gives a stronger electromotive force to produce the currents in the higher resistance of the drum. The errors in the wattmeter are intermediate between those of the ammeter and the voltmeter. While in these instruments the weight is about five times as great as in others, the torque is 28 times as great.

W. H. Pratt stated that the temperature coefficient of the frequency meter was zero because each element was unaffected by temperature.

A. W. Pierce stated that the observations given in the paper were not made by himself.

Clayton H. Sharp then presented a paper by himself and F. M. Farmer entitled "Measuring Maximum Values in High-Voltage Testing." This was followed by a paper on "Measuring Permeability with Alternating Current" by L. T. Robinson and John D. Ball, the latter presenting it.

### Measuring Maximum Voltage.

For breakdown tests the maximum voltage must be known. The spark gap is uncertain and unreliable, as well as inconvenient for very high voltages. The authors use a number of condensers in series across the high voltage, the terminals of one condenser being connected through a synchronous rectifier to an electrostatic voltmeter. The rectifier makes contact only at the peak of the wave, an adjustment for phase being made until the highest reading is obtained. Calibration of the voltmeter in terms of the effective value is obtained by substituting a permanent contact for the intermittent one. Calibration can also be made by plotting the wave form.

### Permeability Measurements with Alternating Current.

It is desirable to find means to measure permeability with alternating current with the same accuracy and speed with which core-loss measurements are made, and preferably upon the same sample. This paper gives preliminary work with ring samples upon a method in which the maximum exciting current is determined by an oscillograph. This does not equal the maximum magnetizing current on account of eddy currents and secondary currents, etc. The value of the exciting current at the instant when the secondary voltage passes through the zero, and the flux is consequently a maximum, may be taken as the value of magnetizing current corresponding to the maximum flux. The use of the maximum exciting current involves an error which is small for thin sheets of high-voltage iron. In the test experiments with material especially well suited to the method, the errors were within 2.5 per cent at 25 and 60 cycles. The maximum exciting current is determined by the double deflection of the oscillograph, without drawing the curve.

E. D. Doyle spoke of the necessity of having high insulation of the voltmeter and gave experimental values demonstrating the effects produced by leakage. Where the leakage is appreciable, it is better to connect a condenser across the terminals of the voltmeter. In the latter case the insulation resistance could be as low as 50 megohms without error. In a case where the resistance was 1,000,000 megohms, there was a difference of 35 per cent with and without the condenser. The original insulation of 8,000,000 megohms had dropped to 1,000,000 with use.

M. G. Lloyd spoke of the limitations to the method of getting permeability values from maximum current. The oscillograph is coming to be used more and more as a measuring instrument, and where accuracy is not important it might be of convenience in measuring maximum voltage.

In reply Dr. Sharp pointed out that the electrostatic voltmeter requires no current.

L. T. Robinson commended the use of the term "peak factor," which had been applied by the author to the reciprocal of the amplitude factor. He considered the term preferable to "crest factor," which had been used in England.

Elihu Thomson also approved of this term but suggested that it be made "wave-peak factor."

J. R. Craighead then presented a paper entitled "Potential-Transformer Testing," after which Frank Wenner presented a paper on "The Testing of Instrument Transformers," by P. G. Agnew and F. B. Silsbee, neither of whom was present. The two papers were discussed together.

### Potential-Transformer Testing.

In the use of the balance method of determining the ratio and phase angle of the primary and secondary voltages of potential transformers, the result obtained is to some extent a function of the resistance of the detector circuit, which connects one terminal of the smaller of the two voltages compared with an adjustable point on the resistance bridging the larger voltage. Under conditions of balance, current is drawn in this circuit practically in quadrature with the voltages compared, unless the voltages are exactly alike in phase and wave form. This current passes through one branch of the bridging resistance, but not through the other; hence the balance will occur when the resistances are not in the exact proportion of the compared voltages, because one part of the resistance carries more current than the other. As this detector current is practically in quadrature with the current in one branch of the resistance, it affects also the phase relations of the voltage drops and the amount of voltage developed across the detector. Hence the phase angle obtained from reading this voltage is usually not correct. This paper considers the relations of the quantities in simple cases and the order of magnitude of the errors. It is concluded that the ratio test is entirely accurate under certain limited conditions; and that a satisfactory accuracy is attained with any of the usual variations of the method when the transformer phase angle does not exceed two degrees. The method of obtaining phase angle from the voltage read across the detector is subject to considerable error and should be avoided, although it can be made fairly accurate under strictly limited conditions.

### The Testing of Instrument Transformers.

This paper describes a new arrangement for testing instrument transformers, which has recently been developed at the Bureau of Standards. For current transformers the ratio is found as formerly by balancing the resistance drops in two resistances, but the phase angle is measured by using the secondary voltage of a mutual inductance to balance the quadrature component of the voltage drops. A vibration galvanometer is used as a detector, and when a complete balance is obtained both ratio and phase angle can be computed from the values of the resistances and mutual inductance. For potential transformers a high resistance is connected across the primary side and the secondary voltage is applied through the galvanometer, potentiometer fashion, to a portion of this resistance. The phase relations are taken care of by inserting a large fixed self-inductance in the low side of the resistance and then shunting a fixed condenser around a variable portion of the latter. This has the effect of neutralizing a portion of the inductance. The vibration used was of the Campbell type with a moving coil specially constructed to give high voltage sensitivity. The instrument could detect 0.5 microvolt at 25 cycles. The advantages of this method are that only a single instrument is required for all ranges of transformers, but one observer is required, and neither a polyphase source, a phase-shifting device nor a rotating commutator is required.

C. H. Sharp claimed that the method presented for testing current transformers had been used by him for several years. He pointed out the advantages of the synchronous rectifier in this work, as it permits the use of a sensitive direct-current instrument. Separate adjustments of the rectifier are made for the in-phase and the out-of-phase components, each of which is balanced independently.

Frederick Bedell referred to the necessary adjustments of a synchronous commutator and favored the use of a driving motor slightly out of synchronism. The instrument deflections then came like beats and it was only necessary to make these maxima disappear.

J. R. Craighead compared the sensibility of the vibration galvanometer with that of the dynamometer which he had been using. For the same de-

flection his instrument required 4.0 microvolts as against 1.0 for the vibration galvanometer, but only 0.1 milliampere as against 1.5. The vibration galvanometer deflects the same way when the balance is off on either side and it is delicate and requires accurate adjustment. To be weighted against this is the necessity of a phase-shifting transformer in the other method, as well as polyphase current.

E. B. Rosa thought that the best method in any particular case depended upon the conditions and upon the observer. He had used a synchronous commutator and galvanometer but had found them unsatisfactory. The vibration galvanometer gave excellent results and had the advantage of ignoring harmonics.

Frank Wenner stated that the vibration galvanometer could be made ten times as sensitive as stated had there been any necessity for it. The present arrangement used by Dr. Agnew is regarded as an improvement upon that used by Dr. Sharp, which had previously been tried.

W. W. Crawford, who had previously worked with Dr. Sharp, favored the use of a synchronous rectifier. He pointed out that this apparatus had a vibrating tongue and was not a commutator with sliding brushes.

The chairman then called Edward B. Rosa to occupy the chair and the latter outlined the history of the horsepower as a unit of power and called attention to the provision in the Standardization Rules for giving this unit a definite value. The Standards Committee does not propose, however, to take any action to have the new definition legalized.

Elihu Thomson then put a motion expressing the thanks of the Institute to President Gano Dunn for the excellent way in which he had conducted the convention, after which President Dunn took the gavel and closed the meeting.

**Power Stations and Industrial Power.**

The parallel session devoted to the subjects of power station and industrial power was called to order by Severn D. Sprong and the first paper presented by A. B. Field, on "Operating Characteristics of Large Turbogenerators."

**Operating Characteristics of Large Turbogenerators.**

The operating requirements of large turbogenerators have materially changed in the past few years concurrently with large changes in the speed and size of units. At the present time 5,000 kilovolt-ampere units at 3,600 revolutions per minute are in operation in this country, and units are in course of construction having a continuous rating of 20,000 kilowatts at 1,500 revolutions per minute and 19,000 kilovolt-amperes at 1,875 revolutions per minute. A feature which is receiving close attention is the amount of current given by these generators at the first instant after short-circuit, and operating engineers are frequently requiring short-circuit tests on new machines purchased when running fully excited. While these requirements are not easy to meet and involve some increased cost, the manufacturers are complying with these demands. This end is attained both by designing the machine to give as low a momentary short-circuit current as is compatible with other desired characteristics and by providing particularly good mechanical bracing of the stator coils. The paper calls attention to some vagueness in the usual method of specifying instantaneous short-circuit currents and proposes a definite conventional agreement on this subject. It also discusses the way in which the initial short-circuit current varies according to the conditions at the instant of short circuit, etc. An example is given of a short-circuit test on the 10,000 kilovolt-ampere, four-pole turbogenerator which gave approximately 20 times normal current on short-circuit at full voltage and which was tested repeatedly by short circuiting with full excitation.

The question of inherent regulation of generators is of less moment than it used to be for various reasons, and a poor regulation is frequently desired in order to reduce the initial current on short-circuit.

With the advent of very large units at high speeds corresponding to two-pole and four-pole constructions, there is a marked tendency towards the use of separately driven external blowers, and the author advocates following the practice, which is now nearly universal in Europe, of installing air filters in the incoming air ducts.

This paper was discussed together with the following one by W. A. Durgin and R. H. Whitehead, on "The Transient Reactions of Alternators," which was presented by Mr. Durgin.

**The Transient Reaction of Alternators.**

This paper is confined to demonstrating the existence of a characteristic of alternators provisionally named the transient impedence and to investigate the influence of the characteristic on (a) maximum and minimum currents flowing through a 12,000-kilowatt turbo-alternator with and without external reactance coils under various short circuit conditions; (b) the maximum and minimum currents into different classes of faults from a system operating several large units in parallel; (c) the maximum cross current obtainable when paralleling a unit to the system considered in (*b*); and (d) the torque developed by the maximum currents of (*a*) and (*b*). From these investigations the authors conclude that the short-circuit currents of alternators are limited by reactances much more complex and much higher than the self-inductive reactances of the armatures but which are constant for similar units and can be obtained for any size and type of generator by simple low-voltage short-circuit tests.

H. M. Hobart approved of separating the ventilating system from the design of the alternator, which would permit greater perfection in the design of the latter. This would also permit the treatment of the air before entering the machine and it could be thoroughly cleaned and afterwards delivered outside the power house.

P. M. Lincoln referred to the formula for the torque developed by short-circuit. He thought the margin for excessive torque was usually so great that no damage could be caused from this.

Henry G. Reist told of a case in which the torque was great enough to shear the coupling bolts and he estimated it as ten times the normal torque. On a steam turbine the effect may be large in comparison with the rotating part of the generator, so that the torque would act on the coupling. This would not be likely to occur upon engine-driven generators. He also favored filtering the air for ventilation, as this country is far behind Europe in that regard.

B. G. Lamme said that large alternators should have considerable reactance. This should be made as high as possible and if it is not enough, additional reactance should be added externally. Short-circuits often occur in the end windings and at the terminals and the internal reactance may prevent a burnout. If the internal reactance be small the machine may be ruined. He told of the grounds which occurred in the field windings of the large generators in the New Haven Railroad power house, which trouble disappeared after heavy copper dampers had been placed on the rotors. Although a large torque might be developed in the rotor it is not necessarily transmitted to the engine, but may be largely absorbed in the rotor. He told of a case where the coupling would only stand three times the rated load but was never injured in spite of frequent short-circuits.

Comfort A. Adams told of the difference in the temperature rise of a machine which he had tested when the air was dry and when it was humid. The temperature rise was very small with humid air. It is difficult to compute the internal reactance of an alternator, which he considered a rather indefinite term. He thought the reactance would rarely be as low as two per cent. A large part of the resistance was in the end connections. It is larger in the low-frequency machines and increased as the cube of the velocity of the rotor, other things being equal.

A. B. Field and W. A. Durgin then closed the discussion.

The next paper was on "Power Efficiency of Rotating Electrical Machines," by E. M. Olin.

### Determination of the Power Efficiency of Rotating Electric Machines.

It may be said that there are two general methods of finding the efficiency of a rotating electrical machine. In one of these the input and the output are measured, and the efficiency computed from these quantities. According to the other method, the losses in the machine are determined and the efficiency calculated by substracting these from the full-load input. An objection to the latter method is sometimes raised on the ground that certain losses vary with the magnitude of the load, and that values of these determined on no-load tests do not hold strictly when the machine is run fully loaded. This paper undertakes to show that efficiencies can be computed satisfactorily from no-load loss tests in all cases, if proper correcting factors are used. In order to make the application of the no-load-loss method of finding efficiency applicable, it is necessary, in some cases, however, to deduce the ratio of the magnitudes of certain losses at full load to the magnitudes of these quantities at no load.

In the derivation of efficiency by the summation of losses, the losses which cannot be determined accurately from no-load measurements are usually the rotation loss and the loss due to eddy currents caused by stray fields of useful currents. Tables found in this paper contain constants to be used in finding what these quantities are at full load when their values at no load are known. The data cover tests of direct-current motors, induction motors, motor-generators and synchronous converters.

Efficiency guarantees based upon a summation of separate losses without changes to allow for increases due to load, are entirely satisfactory as a basis for comparing one manufacturer's machine with those of any other maker. When accurate efficiencies are desirable, it is best, the writer believes, to find them by the summation of losses and the use of such correcting factors as are given in the accompanying tables.

C. M. Green told of his difficulty in making efficiency tests on an old machine with a Brush arc generator. He considered that proper results could only be obtained by measuring input and output, as the field excitation was entirely different with load on and with load off.

B. G. Lamme did not place much faith in input and output tests. There is also a difficulty in determining the losses directly, but he thought we might some day have a correction factor which, applied to the computed losses, would give the correct result.

E. Knowlton then presented a paper by H. M. Hobart and himself entitled "The Squirrel-Cage Induction Generator." This was discussed together with the two following papers.

### The Squirrel-Cage Induction Generator.

The induction generator should have a fairly short air gap, since the exciting current is provided in the same windings that supply current to the external circuit. The current in the armature winding is the resultant of the exciting current and the load current, and the longer the air gap, the greater must the exciting magnetomotive force be. Two stator windings may be employed, but better economy is assured by having only one winding on the stator. The economic field of the induction generator is not limited to unity power-factor loads, but it is best adapted to unity power-factor service, or to systems in which there is a leading current. For high speeds corresponding to the preferable design of steam turbines the induction generator is, in most respects, very appropriate both electrically and mechanically. The smaller amount of copper and the absence of end connections, slip rings and brushes greatly simplify the mechanical construction of the induction rotor.

Distinct advantages are sometimes attained by the use of, say, two 5,000-kilowatt generating sets instead of one 10,000-kilowatt set. For example, assume an equipment of three synchronous and three induction generators in a given station, the induction generators having a capacity of 5,000 kilowatts each, and each synchronous machine having surplus capacity over 5,000 kilowatts sufficient to furnish excitation for the corresponding induction generator. When the load did not exceed 5,000 kilowatts, the station could be operated with one of the synchronous machines. When it was more than 5,000 and less than 10,000 kilowatts, one induction machine could also be operated. Two induction and one synchronous generator could be used when the load was between 10,000 and 15,000 kilowatts. Induction machines of a speed higher than might be practicable for synchronous generators could be employed, and these would therefore have a somewhat smaller steam consumption than synchronous alternators of the same output and frequency. Moreover, the initial outlay for generating sets would in some cases of this sort be less. This superiority would only hold, in the case assumed, when the power-factor was unity or the current leading, as a rule.

W. J. Branson then presented his paper entitled "Single-Phase Induction Motors." This is a mathematical paper which develops a vector analysis of single-phase induction-motor performance. The most important results are the derivation of a formula for the secondary no-load current and the graphical construction of the current circle. Analysis is based on the transformer theory as distinguished from the rotating-field theory. Comparison is given between computed and experimental results.

This was followed by a paper by P. M. Lincoln entitled "Motor Starting Currents as Affecting Large Transmission Systems."

### Motor-Starting Currents as Affecting Large Transmission Systems.

A disposition has been manifested by certain electric-power companies to place a limit upon the size of motors which they will allow upon their circuits. The desire seems to be to avoid tying up too much load in a single piece of apparatus, and to avoid fluctuations in voltage which might result from the starting or operation of large motors. There seems also to be the fear that the cumulative effect of starting many large motors at the same time may cause too large a draft on the generating station.

The first of the above reasons is a legitimate one, and commercial considerations must govern here. The second consideration applies more to city plants whose load is largely for lighting than to longer transmission systems supplying a larger percentage of the total capacity for power.

A certain large transmission in the South, which supplied power to many cotton mills, experienced considerable trouble in picking up its load at the time of the usual morning start of the mills. An investigation was made, in which demand records for nine mills were carefully determined. In one mill the demand during the starting period was found to be less than 70 per cent, in kilovolt-amperes, of the demand during the running period, or about 50 per cent in kilowatts; in another it was only about 70 per cent in kilovolt-amperes, and 62 per cent in kilowatts. In the most severe case investigated the kilovolt-amperes during the starting period exceeded the running kilovolt-amperes by but 50 per cent, while the power taken did not exceed the running power at all.

Induction motors constitute the equipment in all these mills, and the cases cited are typical.

The data obtained in the investigation indicate that if the largest motor in installations like those investigated is not more than 25 per cent of the total motor capacity, the power demand for starting will always be less than that for running, whether the measurement be made in kilowatts or in kilovolt-amperes. It seemed that the difficulty in picking up the load was due to the rate at which kilowatt loads were thrown on the lines rather than to the motor-starting currents.

Lee Hagood referred to the exciting current in the induction generator and its relation to air gap. Referring to Mr. Lincoln's paper he advocated the use of synchronous condensers, as the induction regulator could not take care of the regulation on some systems where the variation was 20 per cent.

Comfort A. Adams thought this question must be decided for each particular case. On long transmission lines it was no doubt cheaper to supply the excitation at the end of the line. He then discussed at some length the computation of losses in the teeth of generators.

E. F. W. Alexanderson spoke of an investigation which he had made to determine a formula for finding the core losses, which are much greater in an induction motor than in a synchronous machine. It had been found that the variations in different machines were too great to permit of any general rule. It was found that the tooth loss was not proportional to the square of the flux-density in the air gap.

Lester McKenney thought that the rule for the largest motor to be per-

mitted on a system should be based on the capacity of the system and not upon the capacity of the mill. The number of motors of the maximum size should also be limited in order to protect other consumers. Poor voltage regulation is only tolerated on account of the large expenditure required for its elimination. Since starting currents are independent of the load, comparisons can best be made by giving the ratio of starting current to full-load running current. Motors with wound rotors have a higher power-factor at starting than squirrel-cage motors, and are therefore to be desired where voltage regulation is important.

H. M. Hobart said that if synchronous condensers become customary to control the power-factor, the usefulness of the induction generator would be widened. He thought that the greater losses in the induction type of machine could be attributed to the American plan of using form-wound coils. European motors of this type show lower losses on account of the smaller air gap.

B. G. Lamme then presented his paper entitled "Characteristics of a Large Unipolar Generator."

### Characteristics of a Large Unipolar Generator.

In 1896 the writer designed a unipolar generator of approximately 3 volts and 6,000 amperes capacity, at a speed of 1,500 revolutions per minute. This machine was built for meter testing. In 1906 an order was taken for a 2,000-kilowatt, 260-volt machine of this type, to be installed in a Portland cement works. A description of this machine and an account of the difficulties encountered in the operation of it are incorporated in this paper.

The first serious trouble to develop in the operation of the generator was the stretching of one of the outer collector rings, which lead to its becoming loose and ceasing to rotate with the inner ring. Solid rings were then installed on the generator. The next difficulties were with the brushes and with an undue wearing of the rings. The first of these was aggravated by the collection of dust under the brushes and was largely overcome by changing the copper-leaf brushes so that the rings ran against the brushes. The application of a weak solution of muriatic acid to the rings by means of a smudge proved to be the best remedy for excessive wear of the collector rings.

In order to overcome the effects of stray magnetic fluxes through the bearings a demagnetizing coil was placed outside the stator frame, at each end of the rotor, between rotor core and bearings.

Later the insulating tubes on the rotor conductors began to break down; also, grounds developed between the collector rings and the core.

By patient study of the difficulties as they developed, however, and the redesign of parts when this was found necessary, satisfactory operation was finally secured. The generator has been in operation for quite a long time now without any trouble at all.

A written discussion was submitted by J. E. Noeggerath, who referred to a former paper of his own describing a machine of very similar design. He had encountered some of the same troubles as Mr. Lamme and some were solved in the same way, while others were solved differently. He found, in contradiction to accepted ideas, that when a magnetic field is set up at right angles to an existing field the one is entirely unaffected by the other, even though the iron may be saturated in one direction.

Elihu Thomson referred to the early machines of this type, some of which had been exhibited at Philadelphia in 1884. He had later built some machines of this type himself which developed difficulties with brushes due to improper construction. He had had the same experience with brushes as Mr. Lamme, and he called attention to the early difficulties with the brushes of the street-railway motors.

The afternoon session was called to order by George F. Sever and the paper by D. B. Rushmore on "Excitation of Alternating-Current Generators," was, in the absence of the author, presented by Emil A. Lof.

### Excitation of Alternating-Current Generators.

For the best automatic voltage regulation, the range of voltage of exciting current from no load to full load at 80 per cent power-factor should not be greater than 1 to 2. For instance, if 70 volts be required at no load, 125 volts should suffice at full load. In general, it may be said that small machines of many poles require large excitation, and large machines with few poles comparatively small excitation. Exciters intended for use in field circuits where automatic voltage regulators are to be used should be of a somewhat different design from those to be employed without a regulator. Exciters should generally be of the compound-wound type.

Alternators may be of the self-exciting type or separate excitation may be required. Composite excitation is sometimes employed.

Mr. Rushmore's paper included a very thorough and practical account of various methods of automatic voltage regulation for alternating-current generators, in addition to a discussion of hand regulation. Photographs of apparatus were shown, and also diagrams of exciter and regulator circuits.

B. G. Lamme started the discussion by some questions regarding the method of winding and compounding. He disapproved of the practice of having a separate exciter for each generator, preferring one or two large independent exciters to supply all of the machines. Separate exciters for each machine are often demanded by customers and there are often individual reasons why they are wanted, but this practice is generally objectionable.

H. M. Hobart agreed that direct-connected exciters were objectionable and hoped that engineers generally would realize this.

J. L. Woodbridge did not think that any greater stability could be obtained by the use of compound exciters.

The next paper, by E. E. F. Creighton and J. T. Wittlesey, on "Localizers, Suppressors and Experiments," was presented by Professor Creighton.

This paper was followed by "Relay Protective Systems," by L. L. Elden, and the two were discussed together.

### Localizers, Suppressors and Experiments.

This paper discusses the application of localizers of faulty feeders and an arcing-ground suppressor to the system of the Public Service Electric Company and gives descriptions of several experimental studies. From the dission it is concluded that generators on a loaded three-phase system maintain practically constant delta potential between phases. The effects of an arcing ground on cable are modified by movements of the melted metal of a lead sheath. On the underside the lead drops away and thus increases the arc length on the upper side. The molten metal runs down into the fault and shortens the arc. For a certain value of resistance to ground the value that drops the potential to ground by about one-third the loss energy in the fault is a maximum of 220 kilowatts. The method of predetermining faults of insulation while the system is in normal operation is proposed in which high-potential direct current is applied at the neutral, protection being given by arresters, suppressors and localizers. All the effects of a grounded neutral may be obtained by connecting aluminum cells between the generator neutral and ground and at the same time all the objectionable effects of short-circuits and cross currents that attend a grounded neutral are avoided.

### Relay Protective Systems.

This paper points out that the standard relay devices in use in alternating-current systems are inadequate to properly protect the apparatus they are intended to protect simply because they do not discriminate between faults and excess-current conditions. On the other hand, in Europe, substantial advances have been made in the art of relay protection, which, as applied to generators, transmission lines and substation apparatus have operated with marked success. A system invented by Messrs. Merz and Price, of London, is apparently, according to the author, the most flexible and best adapted for application to any of the problems of such a character as are met with in the protection of the various apparatus and connecting links comprising the electrical supply system. A considerable portion of the paper is devoted to a description of this system with numerous illustrations showing its application in a number of plants in this country.

D. W. Roper inquired regarding the application of the overload relay in the Merz-Price system. He thought that the application must be to a system in which there was no synchronous apparatus, because such apparatus is

thrown out by heavy short-circuits whether the circuit breakers act or not. His experiments had shown that no matter how quick the action secured by the relays and by the switch itself, the short-circuit always threw out the synchronous apparatus, and this could only be avoided by making the short-circuit through a piece of fuse wire.

H. W. Osgood thought that this system had much to recommend it and its adoption was merely a matter of commercial value. It would involve changing the current transformers in general use and would interfere with the present method of supplying both relays and measuring instruments from the same transformers.

L. C. Nicholson referred to long-distance lines and stated that the determining feature is not whether reverse-current and overload relays operate successfully, but rather the time limit of the oil switch. These occupy at least 16 cycles in operating, which is too long for synchronous apparatus to remain in circuit.

E. E. F. Creighton, in reply to a question, stated that the arcing ground suppressor keeps the ground on continually until the cable is cut out, which is a change from the attachment described last year.

L. L. Elden closed the discussion, stating that the reason for the use of the time-limit relay with the Merz-Price control is to enable faults to be cleared without interrupting the rest of the system. American transformers are not suitable for use with balanced protection.

In the absence of the author the paper by Daniel W. Mead, entitled "Runaway Speed of Water Wheels and Its Effect on Connected Rotary Machinery," was read by title only.

The next paper was by E. C. Morse, entitled "Application of Electric Drive to Paper Machines." This and the following paper, by J. S. Henderson, Jr., entitled "Electric Drive for Paper Calenders," were discussed together.

### Electric Drive for Paper Machines.

The operation of a paper machine consists essentially of the separation of the paper fiber from its suspension in water, first by wire gauze and then by pressing and drying. Certain steps require variable-speed drive; others constant speed. Where steam-engine drive is employed, speed variation is usually obtained by throttling or by variable cut-off. With such drive it is difficult to obtain sufficiently uniform angular velocity.

For paper machines manufacturing one product only, satisfactory speed control may be had from drive with a wound-rotor induction motor; but the poor economy of this machine when operating on resistance is objectionable, and for wide ranges of speed control the use of the direct-current motor becomes necessary. In most paper mills the general mill drive is by means of induction motors. The necessary direct-current generators may be driven either with induction motors or with synchronous motors.

Where speed control is effected by means of resistance in the shunt field of the direct-current motor, the control will be poorest when working upon the lightest paper. Moreover, at lower speeds than the maximum the motor will be working below its capacity. It may also be necessary to supply each separate motor with current from a different dynamo. If control by armature voltage alone be attempted, a separate dynamo for each motor is necessary, and at very low motor speeds the speed regulation is poor. For most cases the conditions can best be met by employing a combination of armature voltage and field current control.

### Application of Electric Drive to Paper Calenders.

The paper as it leaves the paper-making machine does not for many purposes have a sufficiently high glaze, and it is therefore necessary for it to undergo a further process known as calendering. The whole roll may be calendered by passing the paper through a "super" or "web" calender, or the paper may be cut into sheets and these calendered in either a sheet calender or a "plater."

A super calender consists of a stack of metal rolls between which the paper is carried. While the paper is being threaded into the calender a low speed is necessary, and a much higher speed is essential during the calendering process. It is therefore necessary to provide at least two speeds, and the acceleration from low speed to high speed must be smooth in order to prevent tearing the paper. Two-motor drive is employed sometimes, with both motors driving the calender through shafts and clutches. A small motor is employed for threading-in, and a larger one for driving at normal speed, the change from one motor to the other being effected by means of clutches. If it is considered preferable, the shafting and clutches may be done away with and drive effected with motors geared or belted directly to the driving roll. In alternating-current service the larger motor is nearly always an induction machine of the wound-rotor type. If a single motor of this kind be employed, the speed will be very unstable during threading-in. The conditions are better in this respect when a direct-current machine is employed. In this case the motor should be of the interpole type. A further advantage of the direct-current motor is that dynamic braking can be employed to stop the calender quickly.

In driving sheet calenders direct-current motors of the interpole type have been used successfully. It has also been found lately that adjustable speed alternating-current motors are well adapted to this service. Platers are usually driven by a belt from a line shaft. Considerable time has been spent in trying to obtain a motor and a reversible switch that will stand this service. Five reversals of the motor per minute would be necessary and the power would have to be applied in a reverse direction while the motor was running in a given direction. No one has had the courage to try this on large platers.

W. B. Jackson inquired whether a carefully devised electric clutch, such as is used in single-motor printing-press work, could not be used with advantage on paper machines. It could be arranged to instantly open if the paper breaks and thus the flywheel action would be eliminated. Moreover, acceleration from lower to higher speed could be made with more uniformity and exactness.

J. S. Henderson, Jr., thought this style of control would be better on heavy-cardboard, rubber or linoleum calenders. He had seen it work very well but thought it was an unnecessary refinement on a paper-mill drive. It is too expensive to be commercially desirable.

Putnam A. Bates then presented his paper, entitled

### Electricity on the Farm.

This paper calls attention to the attitude on the part of farmers to lessen the amount of labor necessary on the farm by the adoption of electricity. In this work the assistance of the electrical engineer and central-station men should be given. Conditions in the Pacific Coast region, where electric power and light has been employed on a large number of farms for several years, were mentioned and the detailed installations in a number of typical cases described. Special reference was made to the territories served by the Mount Whitney Power & Electric Company and the Pacific Power & Light Company. In the case of the first plant approximately 6,000 horsepower in motors is installed on innumerable farms, ranging in size from 10 to 40 acres. A large proportion of this power is used for irrigation. In this territory power is, in a few cases, sold at $30 per horsepower per annum. There is also a meter rate the essential points of which are: Current is furnished during the six months, February 1 to August 1, at $25 for each horsepower based on a maximum demand, while for current furnished during the remaining months of the year, the rate is three cents per kilowatt-hour, it being agreed that the maximum amount of power to be used during the meter period will be equivalent to at least $6 per horsepower per month of motor rating. Most of the irrigating power is sold for $50 per year for the rated horsepower of the motor. Customers install and maintain all equipment. Considerable data are given on irrigation and the detailed motor application for various farm machines. Numerous illustrations are included in the paper.

This paper was discussed by J. D. Menifield, L. L. Elden, J. A. Moyer and F. B. Sanborn. Mr. Elden called attention to the Edison form, which is an exhibition of motor applications to farming operations maintained by the Edison Electric Illuminating Company of Boston. This company offers to extend its lines almost anywhere to get business, for the load, coming off the peak, is a very attractive one.

Mr. Bates then closed the discussion and the session adjourned.

## THE DISTURBING INFLUENCE OF SOLAR RADIATION ON THE WIRELESS TRANSMISSION OF ENERGY.

By Nikola Tesla.

When Heinrich Hertz announced the results of his famous experiments in confirmation of the Maxwellian electromagnetic theory of light, the scientific mind at once leaped to the conclusion that the newly discovered dark rays might be used as a means for transmitting intelligible messages through space. It was an obvious inference, for heliography, or signalling by beams of light, was a well recognized wireless art. There was no departure in principle, but the actual demonstration of a cherished scientific idea surrounded the novel suggestion with a nimbus of originality and atmosphere of potent achievement. I also caught the fire of enthusiasm but was not long deceived in regard to the practical possibilities of this method of conveying intelligence.

Granted even that all difficulties were successfully overcome, the field of application was manifestly circumscribed. Heliographic signals had been flashed to a distance of 200 miles, but to produce Hertzian rays of such penetrating power as those of light appeared next to impossible, the frequencies obtainable through electrical discharges being necessarily of a much lower order. The rectilinear propagation would limit the action on the receiver to the extent of the horizon and entail interference of obstacles in a straight line joining the stations. The transmission would be subject to the caprices of the air and, chief of all drawbacks, the intensity of disturbances of this character would rapidly diminish with the distance.

But a few tests with apparatus, far ahead of the art of that time, satisfied me that the solution lay in a different direction, and after a careful study of the problem I evolved a new plan which was fully described in my addresses before the Franklin Institute and National Electric Light Association in February and March, 1893. It was an extension of the transmission through a single wire without return, the practicability of which I had already demonstrated. If my ideas were rational, distance was of no consequence and energy could be conveyed from one to any other point of the globe, and in any desired amount. The task was begun under the inspiration of these great possibilities.

While scientific investigation had laid bare all the essential facts relating to Hertz-wave telegraphy, little knowledge was available bearing on the system proposed by me. The very first requirement, of course, was the production of powerful electrical vibrations. To impart these to the earth in an efficient manner, to construct proper receiving apparatus, and develop other technical details could be confidently undertaken. But the all-important question was, how would the planet be affected by the oscillations impressed upon it? Would not the capacity of the terrestrial system, composed of the earth and its conducting envelope, be too great? As to

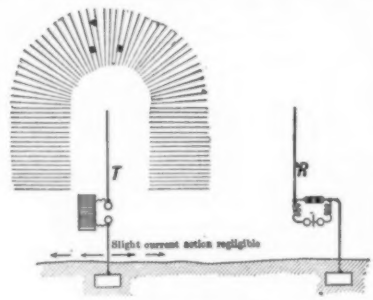



Fig. 1.—Hertz Wave System.

this, the theoretical prospect was for a long time discouraging. I found that currents of high frequency and potential, such as had to be necessarily employed for the purpose, passed freely through air moderately rarefied. Judging from these experiences, the dielectric stratum separating the two conducting spherical surfaces could be scarcely more than 20 kilometers thick and, consequently, the capacity would

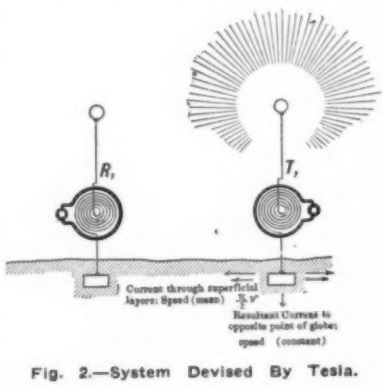



Fig. 2.—System Devised By Tesla.

be over 220,000 microfarads, altogether too great to permit economic transmission of power to distances of commercial importance. Another observation was that these currents cause considerable loss of energy in the air around the wire. That such waste might also occur in the earth's atmosphere was but a logical inference.

A number of years passed in efforts to improve the apparatus and to study the electrical phenomena produced. Finally my labors were rewarded and the truth was positively established: the globe did not act like a conductor of immense capacity and the loss of energy, due to absorption in the air, was insignificant. The exact mode of propagation of the currents from the source and the laws governing the electrical movement had still to be ascertained. Until this was accomplished the new art could not be placed on the plane of scientific engineering. One could bridge the greatest distance by sheer force, there being virtually no limit to the intensity of the vibrations developed by such a transmitter, but the installment of economic plants and the predetermination of the effects, as required in most practical applications, would be impossible.

Such was the state of things in 1899 when I discovered a new difficulty of which I had never thought before. It was an obstacle which could not be overcome by any improvement devised by man and of such nature as to fill me with apprehension that transmission of power without wires might never be quite practicable. I think it useful, in the present phase of development, to acquaint the profession with my investigations.

It is a well known fact that the action on a wireless receiver is appreciably weaker during the day than at night and this is attributed to the effect of sunlight on the elevated aerials, an explanation naturally suggested through an early observation of Heinrich Hertz. Another theory, ingenious but rather fine-spun, is that some of the energy of the waves is absorbed by ions or electrons, freed in sunlight and caused to move in the direction of propagation. The Electrigal Review and Western Electrician of June 1, 1912, contains a report of a test, during the recent solar eclipse, between the station of the Royal Dock Yard in Copenhagen and the Blaavandshuk station on the coast of Jutland, in which it was demonstrated that the signals in that region became more distinct and reliable when the sunlight was partially cut off by the moon. The object of this communication is to show that in all the instances reported the weakening of the impulses was due to an entirely different cause.

It is indispensable to first dispel a few errors under which electricians have labored for years, owing to the tremendous momentum imparted to the scientific mind through the work of Hertz which has hampered independent thought and experiment. To facilitate understanding, attention is called to the annexed diagrams in which Fig. 1 and Fig. 2 represent, respectively, the well known arrangements of circuits in the Hertz-wave system and my own. In the former the transmitting and receiving conductors are separated from the ground through spark gaps, choking coils, and high resistances. This is

necessary, as a ground connection greatly reduces the intensity of the radiation by cutting off half of the oscillator and also by increasing the length of the waves from 40 to 100 per cent, according to the distribution of capacity and inductance. In the system devised by me a connection to earth, either directly or through a condenser, is essential. The receiver, in the first case, is affected only by rays transmitted through the air, conduction being excluded; in the latter instance there is no appreciable radiation and the receiver is energized by currents conducted through the earth while an equivalent electric displacement occurs in the atmosphere.

Now, an error which should be the focus of investigation for experts is, that in the arrangement shown in Fig. 1 the Hertzian effect has been gradually reduced through the lowering of frequency, so as to be negligible when the usual wave-lengths are employed. That the energy is transmitted chiefly, if not wholly, by conduction can be demonstrated in a number of ways.

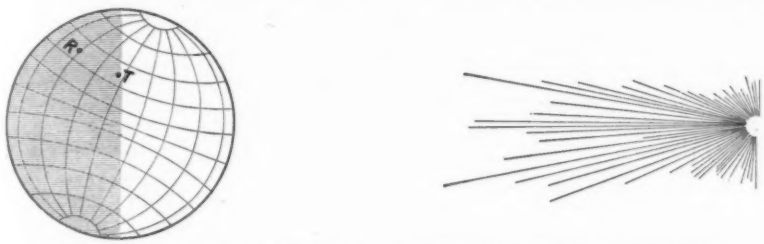



Fig. 3.—Illustrating Disturbing Effect of the Sun on Wireless Transmission.

One is to replace the vertical transmitting wire by a horizontal one of the same effective capacity, when it will be found that the action on the receiver is as before. Another evidence is afforded by quantitative measurement which proves that the energy received does not diminish with the square of the distance, as it should, since the Hertzian radiation propagates in a hemisphere. One more experiment in support of this view may be suggested. When transmission through the ground is prevented or impeded, as by severing the connection or otherwise, the receiver fails to respond, at least when the distance is considerable. The plain fact is that the Hertz waves emitted from the aerial are just as much of a loss of power as the short radiations of heat due to frictional waste in the wire. It has been contended that radiation and conduction might both be utilized in actuating the receiver, but this view is untenable in the light of my discovery of the wonderful law governing the movement of electricity through the globe, which may be conveniently expressed by the statement that the projections of the wave-lengths (measured along the surface) on the earth's diameter or axis of symmetry of movement are all equal. Since the surfaces of the zones so defined are the same the law can also be expressed by stating *that the current sweeps in equal times over equal terrestrial areas.* (See among others "Handbook of Wireless Telegraphy," by James Erskine-Murray.) Thus the velocity of propagation through the superficial layers is variable, dependent on the distance from the transmitter, the mean value being $\pi/2$ times the velocity of light, while the ideal flow along the axis of propagation takes place with a speed of approximately 300,000 kilometers per second.

To illustrate, the current from a transmitter situated at the Atlantic Coast will traverse that ocean—a distance of 4,800 kilometers—in less than 0.006 second with an average speed of 800,000 kilometers. If the signalling were done by Hertz waves the time required would be 0.016 second.

Bearing, then, in mind that the receiver is operated simply by currents conducted along the earth as through a wire, energy radiated playing no part, it will be at once evident that the weakening of the impulses could not be due to any changes in the air, making it turbid or conductive, but should be traced to an effect interfering with the transmission of the current through the superficial layers of the globe. The solar radiations are the primary cause, that is true, not those of light, but of heat. The loss of energy, I have found, is due to the evaporation of the water on that side of the earth which is turned toward the sun, the conducting particles carrying off more or less of the electrical charges imparted to the ground. This subject has been investigated by me for a number of years and on some future occasion I propose to dwell on it more extensively. At present it may be sufficient, for the guidance of experts, to state that the waste of energy is proportional to the product of the square of the electric density induced by the transmitter at the earth's surface and the frequency of the currents. Expressed in this manner it may not appear of very great practical significance. But remembering that the surface density increases with the frequency it may also be stated that the loss is proportional to the cube of the frequency. With waves 300 meters in length economic transmission of energy is out of the question, the loss being too great. When using wave-lengths of 6,000 meters it is still noticeable though not a serious drawback. With wave-lengths of 12,000 meters it becomes quite insignificant and on this fortunate fact rests the future of wireless transmission of energy.

To assist investigation of this interesting and important subject, Fig. 3 has been added, showing the earth in the position of summer solstice with the transmitter just emerging from the shadow. Observation will bring out the fact that the weakening is not noticeable until the aerials have reached a position, with reference to the sun, in which the evaporation of the water is distinctly more rapid. The maximum will not be exactly when the angle of incidence of the sun's rays is greatest, but some time after. It is noteworthy that the experimenters who watched the effect of the recent eclipse, above referred to, have observed the delay.

## Metal Mining in Missouri.

The value of the mine output of silver, copper, lead, and zinc in Missouri for the calendar year 1911, according to the United States Geological Survey, was $30,171,311, compared with $28,086,887 in 1910, an increase of over $2,000,000.

The production of silver amounted to 49,867 fine ounces, valued at $26,430, an increase of 16,771 ounces over 1910. The production of copper was 640,411 pounds, compared with 94,452 pounds in 1910. The quantity of lead concentrates produced increased from 248,058 to 258,240 short tons and the metal content of the lead concentrates increased from 161,016 to 178,868 tons. The low prices paid for zinc concentrate during the first 10 months of 1911 caused a decline in the production of zinc. The output of sphalerite was 217,812 short tons, compared with 232,341 tons in 1910. The production of zinc carbonate and zinc silicate concentrates was only 20,119 tons, which was less than in any previous year since 1907.

## Electrification for Denver & Rio Grande.

Investigation is being made by engineers to determine the feasibility of electrifying the Denver & Rio Grande Railroad across the mountain passes of Colorado.

It is said that if electric current can be purchased for not more than 0.87 cent per kilowatt-hour the company will buy its power.

## The Electric Truck and the Cost of Living.

An observing person, in discussing the question of increased cost of many of the essentials of every day living, said:

"We hear a great deal nowadays about under-production and over-consumption. A prime factor in bringing about the latter is the large number of horses used for haulage and transportation purposes, when the advent and efficient development of the motor truck would seem to indicate no real need for their presence.

"The United States has a yearly hay yield of $743,000,000; a corn crop totaling $1,337,000,000 annually, and an oat crop valued at $334,000,000 during the same period. The greater part of that hay and corn is fed to horses. Suppose acreage necessary to raise the hay were to be cultivated and sowed to grain, and the bulk of the present corn and oat crop devoted to its legitimate purpose—the sustenance of the human race—the present economic difficulty of high prices and under-supply would be, to a great extent, remedied."

The advent of the electric truck has made this condition not so visionary as it seems. The percentage of shrinkage in horse-drawn vehicles in Chicago during the past year amounted to 15.7 per cent for one-horse wagons and 13.5 per cent for two-horse wagons. The aggregate shrinkage is 14.7 per cent for the year. Altogether 6,753 horse-drawn vehicles were discarded in Chicago between May 1, 1911, and May 1, 1912. Since an electric truck handles tonnage equivalent to that of three two-horse wagons, the saving in time, money and congestion of traffic becomes tremendous.

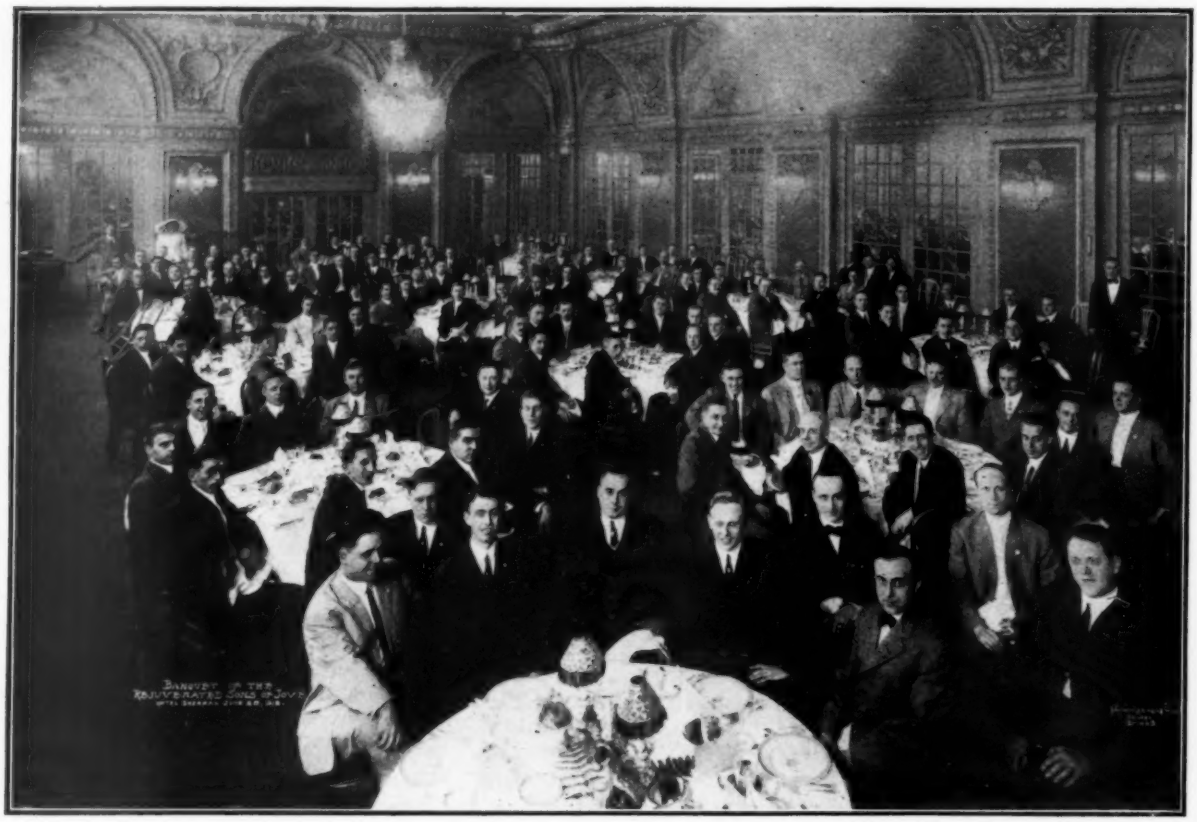
Several unique advantages conspire to make the electric the logical displacer of the horse-drawn truck. The more intelligent of wagon drivers readily familiarize themselves with the operation of an electric truck and cover their old routes as perfectly, as swiftly, as formerly. In nine cases out of ten the routes have become greatly amplified—they cover more territory. And, should they be unable to resist a natural temptation to rush it at top speed back to the garage at the close of the day, the electric refuses to go faster than is necessary. It is geared to run at a certain maximum speed, and no faster. This speed, while ample for commercial purposes, lessens the inclination to tear wear-resistance out of trucks by fast driving.

The average life of an electric truck, based on actual records, is at least 10 years, with a consequent depreciation charge of 10 per cent yearly. The average life of even the best Percheron draft horses is only four years, the depreciation consequently 25 per cent.

All of which will furnish data for some mighty interesting figuring to the man who is worried about how to successfully combat the deadly certainty of depreciation charges in his business.

## Chicago Jovians Hold Rejuvenation.

The Chicago Rejuvenated Sons of Jove held a rejuvenation at the Hotel Sherman, on the evening of June 28, at which a class of 42 was taken into the order. Brief addresses were made by Tenth Jupiter Robert L. Jaynes and James H. Delany, statesman for Illinois, under whose direction the rejuvenation was held. There were 126 members and candidates at the banquet, which was held in the Louis XIV room of the Hotel Sherman. The degree team was in charge of George C. Richards, who acted as Jupiter. The other members of the team were Perry Boole, Pluto; Victor Despard, Vulcan; Edward Kearns, Mars; Leo Mockenhaupt, Hercules; Arthur Selzer, Mercury; F. R. Farmer, Apollo; George Gray, Avrenim; A. A. Gray, Neptune.



Banquet of the Sons of Jove, Hotel Sherman, Chicago, June 28.

# New Electrical and Mechanical Appliances

## Rapid Drilling in One-Inch Plate at Panama Canal.

For the final riveting of the enormous lock gates at the Panama Canal, the McClintic-Marshall Construction Company, of Pittsburgh, Pa., has installed 16 special electrically operated machines for drilling and reaming rivet holes. Each of these machines weighs about six tons and is capable of doing the work of five ordinary reamers.

The machines are designed to run on a standard-gauge track and are mounted on broad adjustable scaffolds which are suspended from brackets by chains from the top of the gate.

The inclined handwheel shown in Fig. 1 operates through a train of gears and moves the machine along the track. The tool can readily be moved, as roller bearings are used. It will be noticed from Fig. 1 that the entire controlling mechanism is placed within easy reach of the operator. A horizontal handwheel actuates suitable reduction gearing and a screw which raises or lowers the spindles, while the quick-return motion through the spindles is actuated by means of a spider handwheel, or by any of four levers. These levers automatically engage the quick-return mechanism and enable the spindles to be run in and out.

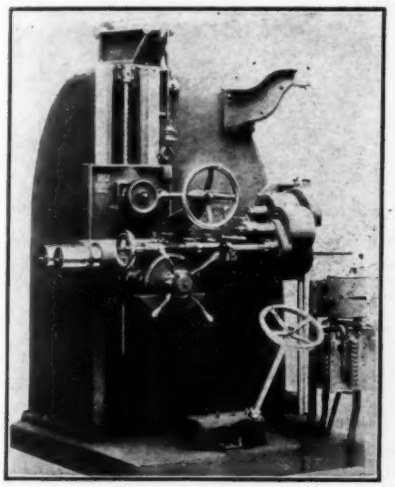


Fig. 1.—Drilling Machine for Panama Canal.

Each machine is provided with four changes of power feed, which are instantly available through the quick-change gear mechanism. The length of the power feed is 16 inches, and the machine is so arranged that either one or both of the spindles can be fed independently.

A handwheel is used for raising and lowering the head, which in turn is accurately counterbalanced so that this raising and lowering is done with the least possible effort. A shackle at the top of the machine serves to attach the crane hook for raising and lowering. Westinghouse direct-current, adjustable-speed, shunt-wound motors, rated at 10 horsepower at 220 volts, are used.

These machines were placed in operation in February, 1912, on the main gates of the upper lock at Gatun, and it is intended to use them on all of the gates in the three sets of locks. They were designed and built by the Foote-Burt Company, of Cleveland, Ohio, especially for use on the Canal. The distinguishing features are their great capacity, a total of nine speeds, varying from very slow for heavy drilling to very high for lighter reaming; and fixed spindles arranged to suit the uniform spacing of rivet holes in the lock gates. On tests made at Gatun, one of the machines drilled one-and-one-sixteenth-inch holes through one-inch plates in four seconds.

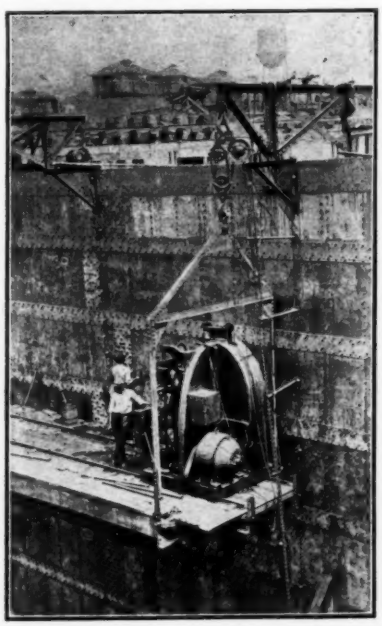
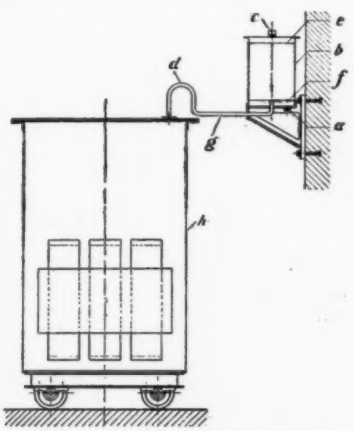


Fig. 2.—Drilling Holes for Lock Gates.

## Siemens Expansion Chamber for Oil-Cooled Transformers.

The increase in use of high-tension transmission which invariably involves the use of transformers has directed a great deal of attention to the character of the oil used therein. It is important that this oil remain unaltered in composition and density as long as possible and that moisture be absolutely excluded from the transformer. It has been found that deterioration of the oil has frequently resulted from some chemical changes and the formation of sludge.

More refined experiments on this matter have demonstrated the fact that pure oil if kept quite cool does not alter even when exposed to the air, but that if the oil is heated and exposed it absorbs oxygen from the atmosphere and begins to undergo a chemical change. In all large transformers considerable heating takes place when under load. It seemed, therefore, to the Siemen-Schuckertwerke, of Berlin, Germany, that it would be desirable to hermetically seal the transformer case and connect it by means of a syphon tube to an expansion tank. This device has been adapted to both small and large transformers.




Expansion Chamber for Transformer.

In the accompanying diagram is shown roughly the manner of installing the expansion tank for large transformers. Connected with the top of the transformer is the U-shaped tube *d*, which acts as a syphon connecting the main transformer case with the lower

portion of the expansion chamber *b*. On the top of this chamber is a safety valve *c*, which allows the air to escape when the oil expands and again to enter when the oil contracts with decrease of load. The end of the syphon tube is so arranged that it is always submerged, even though the oil is at its minimum level *f*. At the bottom of the expansion chamber is a small drain *a*, which permits any moisture which may have entered at the safety valve *c* to be drawn off from the bottom of the oil. The syphon tube being made of metal insures that the oil that reaches the expansion chamber is relatively cold, so that the oil exposed to the air in that chamber is not appreciably altered by oxidation. The device also insures that no moisture enters the transformer itself.

It is believed that this chamber will prove effective in maintaining the insulating qualities of the oil.

## A New Form of Socket Regulation for Incandescent Lamps.

The accompanying illustration shows a new form of regulator for incandescent lamps. This is a small compact attachment to be inserted between the lamp and the socket, and the light

"Any Lite" Dimming Regulator.

is regulated by means of a small screw turning it up or down at will. The feature of this device, which is called the "Any Lite" regulator, is a wire resistance wound upon a bobbin across which a wipe contact is made by a durable brass spring on the end of the screw shaft. The resistance is contained within a ventilated brass casing, and the device is made of heavy stampings so as to secure a rigid, reliable piece of apparatus. This regulator is manufactured in several assortments of brasses and bronzes to match different kinds of electrical fixtures, and is being placed on the market by the Any Lite Incandescent Lamp Regulator Company, Clogg Building, North Yakima, Wash.

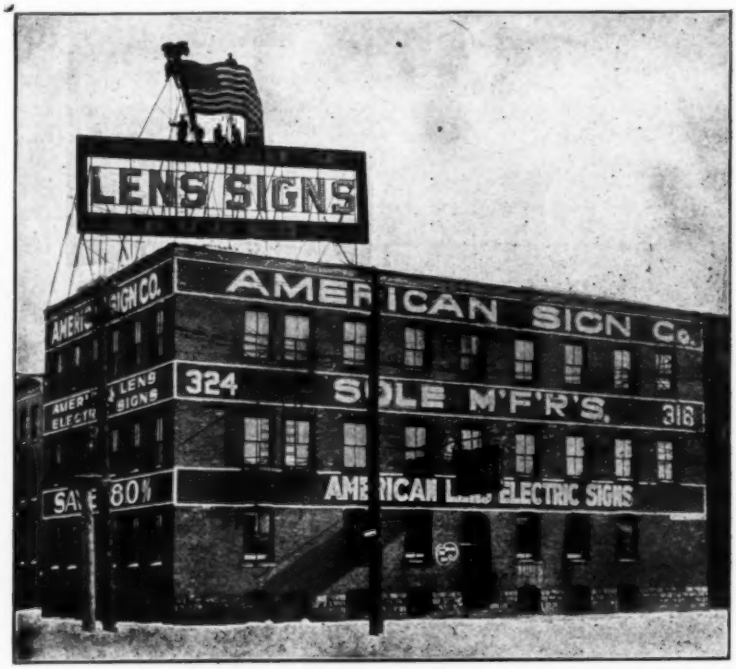
The Government has awarded contracts for portable ventilating sets for the navy yards at Portsmouth, Brooklyn, Philadelphia, Norfolk and Mare Island to the Electric Service Company, of Philadelphia, Pa., at $5,748.25.

## "American Lens" Electric Sign.

The American Sign Company, Kalamazoo, Mich., has placed on the market a unique electric sign for which it claims some distinct advantages. The sign is made of all-metal construction and cannot warp, check or decay. Angle steel framework is used, and when the size requires it inside cross braces are employed. The whole sign is made to withstand the severest wind storms. The lettering and inside of the sign are finished with specially imported enamel and permanent pigment colors. Genuine gold leaf is used for the outside decorations, making an attractive and durable sign by day as well as by night.

A special feature of this sign is the "American Lens" which preserves the outline of the letter, is claimed to read at a great distance not only at right angles, but at an angle of thirty degrees to the sign, and it is stated that it consumes 80 per cent less current than the ordinary all-lamp electric sign. The "American Lens" electric sign is illuminated from the interior and any desired type of incandescent lamp can be used. The powerful meniscus searchlight lens, which is a patented feature of the sign, is fastened to the iron plate by a screw construction. This eliminates the possibility of the lens becoming loosened and dropping out.

The American Sign Company was organized in Kalamazoo in October, 1908, by C. M. Davis and W. R. Fox, of Kalamazoo, and H. F. Coon, of Detroit, the active management of the company devolving upon Mr. Davis. The company has grown rapidly from a very small organization to one employing a half a hundred hands, and occupying a four-story brick building. The company believes in using its own signs for advertising purposes, as may be noted from the accompanying illustration. The huge American flag shown on the top of the building and the eagle surmounting the flag pole are operated by a flashing device, and this is claimed to be one of the most beautiful and impressive flashing signs in the country. The eagle has a three-foot spread of wings, and the flag is 12 by 18 feet in dimensions. The whole sign is 30 by 44 feet. When used as a flashing sign the interior of the sign is provided with a series of partitions, which is the invention of the superintendent of the factory, Edward Bambeck, and which gives a dissolving effect of the light into the shadows.




Home of the "American Lens" Signs.

This sign is being used by merchants in every part of the country, and the manufacturers state that despite the low consumption of current it is a great load builder for the central station.

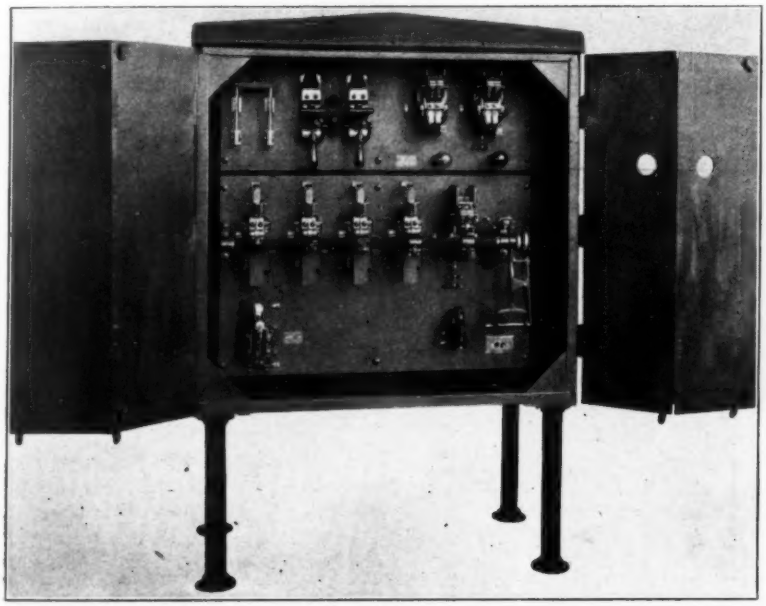
The Delaware & Hudson Railroad Company has lately placed an order with the Western Electric Company for equipment to be used in installing the first telephone train dispatching system to be used by that road. The train wire to be installed will extend from Albany to Troy, New York, with the dispatcher at Albany, and will take in the various yard offices and stations between those two points. A total of 12 stations will be equipped within this distance of eight miles.

## A Safeguarded Fire-Pump Control Panel.

It is estimated that the property loss in the United States from fires during the last 33 years totals the enormous sum of $5,147,253,724.

This enormous loss certainly drives home the conviction that the fire hazard is of no small magnitude. It is imperative, therefore, that the most approved and up-to-date systems for fire protection be installed. Many plants are now equipped with automatic water-sprinkling systems and protection is afforded, provided the water pressure is maintained. In the case where the pumping installation belongs to the plant, this requirement means that the motor and control apparatus must be absolutely reliable so that no fault will develop and make it necessary to shut the motor down and stop the pump.

A fire-pump motor with its control



Combined Automatic and Manual Control Panel for 100-Horsepower Motor.

panel is designed for emergency conditions and consequently is seldom operated. All operating parts of the control panel shown herewith have non-corrosive bearings so that they cannot rust on account of long disuse and prevent the motor from operating at the critical time.

The complete panel is inclosed in a splash-roof case which effectively protects it from dripping water and also prevents the entrance of water if a stream from a fire hose should strike it. The panel is mounted on four pipe supports so that it cannot be easily reached by water accumulating where the panel is installed.

The pressure governor connected to the water-pressure system closes the control circuit of the panel as soon as the water pressure falls to a predetermined value, starting the motor with all the starting resistance in circuit. Current-limit contactors automatically accelerate the motor by cutting out successive steps of this resistance.

If desired the motor may be started by hand by means of the operating lever at the right of the contactor. This method forces the contactors to close in their proper sequence by means of a cam shaft.

The panel is fully protected against failure of voltage and also from overloading. Two lamps are mounted on the panel, the one serving to indicate when there is voltage on the line while the other indicates to the operator that the motor is running. The lights are visible through glass bull's eyes in the inclosing cover.

The contactors which open the main-line circuit are provided with powerful magnetic blowouts to snuff out the arc when the circuit is opened and thus prevent any burning of contactor parts. The circuit-breaker used for overload protection has been designed especially for very severe service. All current-carrying parts are of ample cross section ensuring continuous operation without overheating.

The iron-grid starting resistance is of sufficient current-carrying capacity for frequent starting of the motor. Frequent starting might be required in case one sprinkler head only should open, as this would cause a small flow of water in the pipes and the pump would be able to quickly refill the tank. At this point the control system stops the motor, only to start it again when the pressure falls to the value at which the pressure governor is adjusted to operate.

The above description applies to panels controlling direct-current motors. There is a similar panel for controlling the slip-ring type of induction motors, where automatic control is obtained by means of a motor-operated dial switch. The later may also be operated by hand if desired. The statements made above regarding the general construction, operating conditions and reliability of the direct-current control panels apply also to panels operating on alternating-current circuits.

It is interesting to note that the use of these panels is not confined to fire-pump service alone, as they may be used to advantage in hotels, office buildings, stores, etc., for supplementing the city service and insuring a sufficient water pressure for every-day use. They may also be used in isolated places, such as summer hotels, manufacturing plants, etc., where electric power is available for pumping.

The control apparatus described above is manufactured by the General Electric Company, Schenectady, N. Y.

## An Improved Shurlok Locking Socket.

One of the most successful wiring devices that has been placed on the

Shurlok and Seal.

market within recent years is the Shurlok locking socket for incandescent lamps, manufactured by Pass & Seymour, Incorporated, Solvay, N. Y. The Shurlok socket locks the lamp, and affords absolute protection to the lamp and reflector against theft. Some electric lighting companies, however, have desired even greater protection, as evidence is available that attempts have been made to tamper with the lock. In order to meet this requirement the manufacturers announce that a small hole will be drilled to order and without charge through the end of the fiber and the shell holding the lock. It will then be possible for the electric lighting company to pass a small wire through this hole and attach its private seal in the manner shown in the accompanying illustration. This method of sealing the lock shows at a glance whether anyone has attempted to tamper with the lock, because it will be impossible to insert the key until this private seal is destroyed.

## High-Potential Fuse and Mounting.

The general tendency towards increased station capacity, voltages and interconnection of circuits giving a high reserve energy under short-circuit conditions, has demonstrated the need of better types of high-tension fuses than have been available heretofore.

As is well known, a source of electrical energy has a reserve power under short-circuit conditions, greatly in excess of its normal rated capacity. A fuse in addition to being required to rupture the energy of its particular circuit, must also under severe conditions, interrupt the entire energy of that part of the generating system of which its particular circuit is an element.

The ordinary type of fuse, while satisfactory under the former conditions of comparatively small station capacities, does not meet the conditions of modern operation where the ultimate breaking capacity is enormously high as compared to the station of five years ago. A new type of high-tension fuse with its insulating mounting is shown in the accompanying illustration and provides a dependable means of interrupting high-voltage heavy-capacity

High-Potential Fuse.

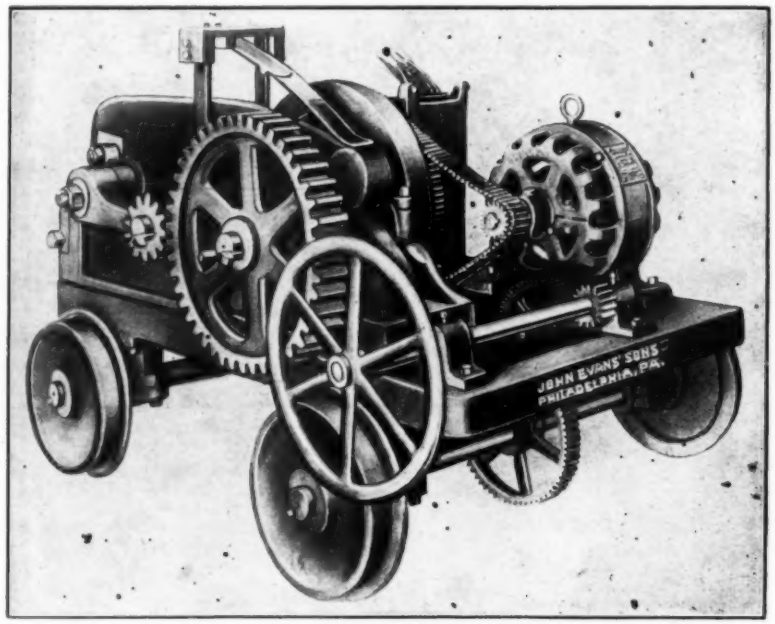
circuits. This equipment, supplied by the Delta-Star Electric Company, of Chicago, Ill., consists of a short fusible element immersed in a non-combustible arc-extinguishing liquid. The fusible part is held under spring tension and passes through a float, the normal position of which is near the top of the sealed glass tube. Upon melting of the fuse, the spring rapidly pulls the float down through the liquid body, effectually and quickly extinguishing the arc, at the same time giving a positive indication of an open circuit. While the tube is hermetically sealed, the upper end is so constructed that a small vent will open at a certain pressure, thus forming an effective safeguard against breaking of the tube in case of extremely violent short-circuits.

These fuses are supplied for all commercial potentials up to and including 66,000 volts, thus opening up a field heretofore confined to the more expensive types of oil circuit-breakers. For indoor or station mounting, the fuse is supported on corrugated porcelain pillars mounted on a marble base, thus conforming to standard disconnecting-switch practice. For pipe-frame mounting, the insulators are of the standard petticoat type, provided with steel base pins and U bolts for clamping the iron pipe.

For protecting outdoor substations, pole-type transformers and sections of lines, the fuse mounting is of the weatherproof form consisting of two petticoat insulators so arranged as to be suspended from cross-arms in a manner similar to that employed with the weatherproof inverted type of disconnecting switches.

## A Portable Motor-Operated Shear.

A novel motor application is shown in the accompanying illustration of a




Motor-Driven Shear.

John Evans' Sons shear mounted with its driving motor on a small flat car. The places where this machine may find a use are limited, but it is a very valuable adjunct to wholesale hardware houses, factory storerooms, railroad shops, or in any place where metal bar or strap is handled.

The car is designed for standard-gauge track, being propelled by the handwheel. The car is run along on a track in front of the bins containing the material to any particular point where the required lengths of the desired material are cut.

The shear motor is of Westinghouse make, 7.5 horsepower, operating on three-phase current. The current is conveyed to the motor by means of a long flexible cable or, when used over a track of any length, a number of junction boxes for making connections to the motor is more satisfactory.

## Telephone Train Dispatching on the Washington & Old Dominion Railway.

The Washington & Old Dominion Railway Company which operates from Georgetown, D. C., to Bluemont, a distance of approximately 55 miles as the electrification of a former division of the Southern Railway, has placed an order with the Western Electric Company for apparatus to be used in installing a complete telephone train dispatching system. This will be the first of its kind used on this road.

The system will comprise fifteen No. 101-B selector sets, containing the standard Western Electric No. 50 type selector. The telephone sets will have the "folding gate" type transmitter arms. Four selectively operated semaphores will be placed at points along the right of way. These are controlled by the dispatcher and are located where there are no operators.

The train dispatcher's office will be equipped with a Western Electric No. 1,800 sectional unit-type magneto switchboard. From this board 15 telephone circuits will radiate, the arrangement being such that the dispatcher can control the train wire and switchboard lines together or separately.

Recent tests made at the Pasteur Institute in Paris on sterilization of River Seine water by means of ultra-violet rays from quartz-tube lamps have been very successful.

# Current Electrical News

## LIGHTING AND POWER.

*(Special Correspondence.)*

EGAN, S. D.—A stock company has been organized to establish and operate a local electric light plant. C.

DUBUQUE, IOWA.—Boulevard lights will be installed on two blocks of Main Street. C.

BOYLSTON, MASS. — This town has voted to install a municipal electric plant at a cost of $8,000.

CLEVELAND, O.—The Plain Dealer Publishing Company is contemplating enlarging its power plant.

PALESTINE, TEX.—The City Commission is considering plans for a "White Way" street-lighting system.

BURLINGTON, IOWA.—Plans are being considered for installing an electric light plant in the Y. M. C. A. Building.

REDFIELD, S. D.—The new lighting system will be extended and cluster lights will be installed on Humboldt Street. C.

FARGO, N. D.—The Union Light, Heat & Power Company will spend about $35,000 in improvements to the local plant.

FRANKFORT, KY. — Ornamental street lighting is planned by the Commercial Club, of which Eli H. Brown is secretary. G.

COLUMBIA, TENN. — The Ashton Roller Mills has decided to install equipment for the generation of hydro-electric current. G.

OMAHA, NEB.—The City Council has passed an ordinance calling for 122 new flaming arc lights for the retail section of this city.

AUSTIN, TEX.—Austin is considering plans for the installation of an ornamental street-lighting system on North Congress Avenue.

WATERVILLE, ME.—The Central Maine Power Company plans to immediately commence work on a 40-mile transmission line to Rockland.

ST. LOUIS, MO.—The National Enamel & Stamping Company has under consideration the installation of an electric light and power plant.

PARSONS, KANS.—A franchise has been granted to the Union Traction Company, Independence, for an electric railway and power plant in this city.

AMESBURY, MASS.—The Amesbury Electric Light Company expects to issue $14,700 additional capital stock, the proceeds to be used for extensions.

ALBERT LEA, MINN.—The Minnesota Gas & Electric Company has bought a site and will install a modern light and power generating plant. C.

GEORGETOWN, MISS. — Wilson Hemingway, Jr., has been granted a franchise to install an electric light plant and water-works system in this city.

SAN FRANCISCO, CAL. — The Great Western Power Company has been granted permission to extend its lines, in Sonoma, Napa and Solano counties.

CEDAR RAPIDS, IOWA.—The Cedar Rapids & Iowa City Railway Company has secured a franchise to light the towns of Whittier, Viola and Stone City. C.

HARLEM, MONT.—Pete Mitchell is interested in the organization of the Harlem Electric Company, which is completing plans for the installation of its new plant.

WILMINGTON, DEL.—A Delaware charter has been granted to the Consolidated Cities Light, Power & Traction Company, having a capital stock of $10,000,000.

WYOMING, MICH. — The Grand Rapids-Muskegon Power Company has been granted a franchise to extend its service into the district between this city and Grandville.

THERMOPOLIS, WYO.—It is reported that the Big Horn Collieries Company will extend its line to this city and furnish electricity for light and power purposes.

PIERZ, MINN.—The Electric & Water Power Company of Little Falls, has submitted a proposition to the Commercial Club to furnish electric lights for the village. C.

EAGLE, W. VA.—The St. Clair Colliery Company is said to be in the market for a 150-kilowatt to 200-kilowatt 250-volt direct-current generator with pulley and switchboard.

MANANAH, MINN.—A party of capitalists has secured an option on the mill and power plant with the intention of furnishing electric power to Eden Valley and Watkins. C.

CHATTANOOGA, TENN.—Merrill B. Parker is in the market for power equipment, including a 50-kilowatt generator, four motors, from 5 to 20 horsepower, and a switchboard. G.

TESCOTT, KANS.—Rollins & Westover, consulting engineers, Kansas City, Mo., are preparing plans for an electric light plant to be erected at this place at an estimated cost of $25,000.

HOWARD LAKE, MINN.—A 20-year franchise has been granted to the Central Minnesota Light & Power Company to construct and operate an electric system in this village.

BELLEVUE, O.—That this city is to have a municipal lighting plant seems now to be assured as the City Council has unanimously passed a $35,000 bond issue for this purpose. H.

ALBANY, N. Y.—Permission has been granted to the Tri-County Light & Power Company to exercise franchises in the town of Gilboa to furnish electricity for light, heat and power.

PORTLAND, ME.—Federal Power & Light Company has been incorporated with a capital stock of $2,000,000. John N. Pierce is president of the Company and Ernest M. White, treasurer.

WATERVILLE, ME.—The Central Maine Power Company has acquired rights to power sites in Clinton, Canaan and Skowegan, and the Ricker mills and mill privileges on Sebasticook River.

KNOXVILLE, TENN.—The Knoxville Welding Company is equipping a new plant for electric welding. An electrically operated air compressor is one of the items of equipment which will be purchased. G.

LAFAYETTE, IND.—The Esterline Electric Company has increased its capital stock from $50,000 to $250,000. The money is to be used to extend the plant and take care of increasing business. J. W. Esterline is president. S.

ARTESIA, N. M.—John C. Keys, of Oklahoma City, Okla., who holds a controlling interest in the Artesia Light & Power Company, plans to make extensive improvements to the plant and extend the transmission lines.

PORTLAND, ORE.—Bids are being asked by the trustees of Reed College for the erection of a light and power plant, and for the installation of machinery. The plant is also to provide for the heating of the buildings.

HOPKINTON, IOWA.—The Milroy Electric Light & Power Company has been granted a 25-year franchise, and many improvements will be made in the local system. Electroliers will be installed in the business section, it is stated. C.

TURNER'S FALLS, MASS.—Fred T. Ley, who is associated with the Turner's Falls Company, has secured options on large tracts of land on Miller's River controlling valuable water sites, which are estimated will develop 20,000 horsepower.

NEW KINGSTON, PA.—The New Kingston Electric Light, Heat & Power Company has been incorporated with a capital stock of $5,000. The incorporators are Charles and John Hetrick, J. L. V. Smith, C. H. Bear, W. H. Ray and Frank Bricker.

MARSHALLTOWN, IOWA.—W. G. Dows and J. A. Reed, of Cedar Rapids, are among the purchasers of the Marshalltown Light, Power & Railway Company property. It is stated that plans are under way for extending and enlarging the system.

CAMDEN, PA.—The Long Beach Electric Light & Power Company has has been incorporated with a capital stock of $50,000 for the purpose of operating a lighting plant. The incorporators are Charles H. Large, C. U. Martin and John A. MacPeak.

MONTPELIER, IND.—The Montpelier Water & Light plant will be sold to the highest bidder by the receiver within a few weeks. It will be necessary to expend considerable money

for improvements, machinery, etc., to put the plant in good condition. S.

MORRISTOWN, TENN.—The Morristown Power & Development Company will develop water power sites in Eastern Tennessee. It is expected that the corporation will act as a holding company. John Loop, W. C. Hale, R. F. Taylor and others are interested. G.

DOVER, DEL.—The Continental Public Service Company has been incorporated with a capital stock of $50,000,000. The company will construct and operate electric light and gas plants to furnish power, heat and light. Offices will be maintained in both Chicago and New York.

ROBINSON, ILL.—Henry G. Starr, of Chicago, and J. P. Goodrich, of Indianapolis, who have purchased the property of the Robinson Water, Light & Heat Company, will duplicate the present electric generating unit and equip the present steam-pumping plant for electrical operation.

DENVER, COLO.—The Interurban Power & Light Company has been incorporated with a capital stock of $2,000,000 by W. M. Wilson and B. N. Weinsheim. The company will generate and sell power, construct and manipulate electric railways in and around Colorado Springs.

LYNCHBURG, VA.—Bids are being asked by the Virginia State Epileptic Colony for one 150-horsepower water-tube boiler and an 80-horsepower engine direct-connected to 35-kilowatt, 40-kilowatt and 50-kilowatt alternating-current generators. D. S. Priddy, of this place, is superintendent.

DENVER, COLO.—The House of the Good Shepherd is advertising for bids for a power plant, consisting of two 25-kilowatt, 125-volt direct-current generators, engines, boilers, etc. It is the intention to use the plant for supplying electricity to operate elevator motors and lighting buildings.

MANHATTAN, N. Y.— Columbia Light, Heat & Power Company has been incorporated with a capital stock of $25,000 for the purpose of manufacturing gas and electricity. The incorporators are George Leary, Adelbert W. Bailey, New York City, and Frederick H. Schomburg, Brooklyn.

FORT DODGE, IOWA.—The Fort Dodge Water Power Company has been incorporated with a capital stock of $500,000 for the purpose of installing a power plant in Des Moines River near this place. G. D. Tremain, Humboldt, is president of the new company, and J. R. Mulroney, Fort Dodge, treasurer.

PETERSBURG, IND.—Capitalized at $25,000, the Pike County Electric Light & Power Company has been incorporated for the purpose of building and operating a plant to furnish Petersburg and surrounding community with electric light and power. The directors are S. F. Seager, W. D. Hodson and W. F. McKasey. S.

FAYETTE, N. C.—The Fayette Light & Power Company has been incorporated with a capital stock of $150,000 by W. W. Randolph, New York; John Rurlin and Thomas Badger, of Fayetteville. This company will take over the holdings of the Fayetteville Gas & Electric Company and the street railway system of Fayetteville.

PUEBLA, MEX.—The Puebla Tramway & Power Company plans to construct power transmission lines to all the principal cities and industrial centers of the states of Puebla and Vera Cruz. One line will run to the city of Vera Cruz, where the power will be used by the Vera Cruz Electric Light, Power & Traction Company.

LEWISTON, ME.—The Sheepscot Valley Power Company has been incorporated with a capital stock of $200,000. The company intends to develop important power privileges at Cooper's Mills and has been granted the right to generate, sell and distribute electricity for lighting, heating, manufacturing and mechanical purposes in a number of towns.

BOSTON, MASS.—South Carolina Light, Power & Railway Company has been incorporated with a capital stock of $5,000,000, for the purpose of manufacturing cotton and woolen goods, grinding grain and furnishing electricity. Herbert A. Wadleigh, Winchester, Mass., is president of the company. Offices will be maintained at both Boston and Spartansburg, S. C.

LINCOLN, NEB.—The Commonwealth Development Company has been incorporated with a capital stock of $7,500,000 by W. E. Sharp, A. W. Field, C. T. Boggs, S. H. Burnam, of Lincoln; A. C. Koenig, of Omaha; J. M. Bramlette, Detroit, Mich; and A. A. Ladd, Lansing, Mich. The purpose of the company is to carry out a large hydro-electric project on the Loup River.

COLFAX, CAL.—For the purpose of lighting all the ranches between this city and Clipper Gap and the residences in Colfax, Clipper Gap, Applegate and Welmar, the Independent Power & Lighting Company is being organized. The promoters are members of the Colfax Suburban Telephone Company, but other stockholders will be taken in and the two companies will operate as separate organizations.

TAMPICO, MEX.—The Tampico Electric Light, Power & Traction Company, which was recently organized in London, England, as a subsidiary of S. Pearson & Son, Limited, has formerly taken over the electric power and lighting plant here of the Compagnia Fuerza Electrica and the J. F. Vorde Company, also the street railway system which is now operated by mules. The new company has a capital stock of $1,000,000 gold. It is announced that it will expend approximately $1,250,000 gold in extending the line of the street railway system to Labarca, at the mouth of the Panuco River, six miles below Tampico, and the converting of the system into electric traction. The company will also install a new electric power plant of 3,000 horsepower here. The same interests have been granted a concession by the Mexican Government for the installation of a wireless telegraph station at Tampico. D.

## TELEPHONE AND TELEGRAPH.

*(Special Correspondence.)*

CHOKIO, MINN.—The Chokio-Southwestern Telephone Company will construct about 15 miles of new lines.

COLFAX, CAL.—The Colfax Suburban Telephone Company has made arrangements for improvements to its system.

TOLEDO, O.—The Cleveland Telephone Company is making plans to spend about $18,000 on laying additional underground cable.

NORTH BEND, ORE.—R. P. Kehoe states that he and others are making preparations to build a modern telephone system here.

BIRMINGHAM, KY.—Birmingham Telephone Company has been incorporated with a capital stock of $350 by M. R. Cox, V. M. Cox and Charles Smith.

HAMPTON, ARK.—The Hampton Telephone Company has filed articles of incorporation with a capital stock of $10,000 by H. C. Black, W. R. Fea and C. C. Mason.

LYNN, IND.—The Lynn Local Telephone Company has been incorporated with a capital stock of $50,000. The directors are S. C. Bowen, J. S. Blair and W. R. Holliday.

DeKALB, N. Y.—Maple Ridge Rural Telephone Company has been incorporated with a capital stock of $3,000 by Ervin Streeter, Horace T. Streeter and Donald N. Ritchie, all of DeKalb.

OKLAHOMA CITY, OKLA.—South Flat Telephone Company of Elmwood has been incorporated with a capital stock of $2,000, by T. S. Pinnell, P. J. Hiebert and John Strague, all of Elmwood. P.

WEST LEBANON, IND.—Cadwallader Telephone Company has been incorporated with a capital stock of $100,000. The directors are Ira Cadwallader, C. L. Messner and J. H. Brenner.

TOWNER, N. D.—The Alfalfa Valley Company has been incorporated with a capital stock of $25,000. E. C. Sargent, S. W. Wheelon and T. J. Cummings, all of Towner, are the incorporators.

BATESVILLE, TEX.—The Batesville Telephone Company is constructing an extension of its long-distance system between Batesville to Pearsall and plans to make other improvements to its property. D.

CHESAW, WASH.—The property of the Chesaw-Myncaster Telephone Company has been leased to the Farmers' Telephone Company for a period of ten years, and extensive additions will be made to the system.

GALVESTON, TEX.—The Commissioners Court of this county has granted the League City Telephone Company a franchise for the construction of telephone lines through several school districts of the county. D.

NUCKOLS, KY.—Farmers' Mutual Co-operation Telephone Company has been incorporated with a capital stock of $300. The incorporators are W. M. Humphrey, J. D. Vance, A. H. Lee, W. W. Mitchell and J. W. Taylor.

NASHVILLE, TENN.—Articles of incorporation have been granted to the Union Telephone Company, of Lauderdale, with a capital stock of $500.

WASHINGTON, ILL.—Washington Home Telephone Company has been incorporated with a capital stock of $5,000 for the purpose of engaging in a general telephone business. E. S. Sterritt, C. A. Camp and C. B. Cheadle are the incorporators.

LEWISTON, IDAHO.—The Inland Telephone & Telegraph Company plans to construct lines between Spokane and this city, where connection will be made with the Nezperce & Cooperative Telephone Company. The total cost will be approximately $125,000.

LYNN, IND.—The Lynn Local Tele-

phone Company has filed articles of incorporation with the secretary of state. The object of this association is the establishing of an exchange, building and operating telephone lines in and connecting the towns of Lynn, Cartos, Modoc, Lasantville, Parks, Farmland, Winchester, Union City and Spartensburg. S. C. Brown is president. S.

HOPKINSVILLE, KY.—The Christian Todd Telephone Company has been incorporated with a capital stock of $1,000,000. The company has the right to do anything necessary to owning and operating telephone and telegraph lines and exchanges. The incorporators are J. M. B. Hoxey and R. E. Hastings, of Atlanta: R. E. Cooper and F. G. Hoge, of Hopkinsville; B. B. Petrie, of Elkton, and J. B. Hoge, of Cleveland, O.

## ELECTRIC RAILWAYS.

*(Special Correspondence.)*

SAN DIEGO, CAL.—The street car line to Angelus Heights is soon to be electrified.

BILLINGS, MONT.—The Billings Traction Company will construct new lines this summer. C.

SUPERIOR, WIS.—The Duluth Street Railway Company is planning street car line extension. C.

MILWAUKEE, WIS.—The Council has ordered the street car company to replace old lines on various streets.

HENDERSONVILLE, N. C.—The Laurel Park Street Railway Company, says a report, will convert its steam line to electric operation.

REDONDO, CAL.—Right of way has been secured and survey made by the Pacific Electric Company for the line from this city to Torrence.

ST. AUGUSTINE, FLA.—The St. John's Light & Power Company has under consideration the extension of its electric railway to New Augustine.

HOUSTON, TEX.—The Houston Electric Company which operates the street railway system here will expend more than $250,000 in improvements.

LOS ANGELES, CAL.—Rights of way have been cleared so construction may begin on the extension of the Riverside-Bloomington electric line to Rialto.

CENTERVILLE, IOWA.—Messrs Sawyer and Boland have been granted a franchise for an interurban line, and work will begin at once on construction to Albia. C.

LITTLE ROCK, ARK.—A syndicate of business men, headed by A. C. Read, vice-president of the Southern Trust Company, has under way plans for building certain street car lines in this city.

TULSA, OKLA.—The Tulsa Street Railway Company is reported to have sold $1,000,000 of 5 per cent 20-year bonds through the Bankers' Trust Company, of New York, and will make extensions and improvements.

LOS ANGELES, CAL.—The Santa Fe Railroad is preparing to spend $10,000 for block signals in Southern California and $200,000 to build and equip an electric generating plant to supply current to work the signals.

LOGAN, UTAH.—The Boosters' Club of this place is interested in an electric railroad which is being proposed by Mr. Wells to operate in Cache County, and have promised to subscribe $25,000 to the enterprise.

SCOTTSBURG, IND.—Work is to be commenced soon on the traction line to run from Madison to Scottsburg. The plan now is to extend the line through Salem and Campbellsburg. John E. Greely has been made general manager. S.

ATLANTA, GA.—The Georgia Traction Company has been incorporated with a capital stock of $150,000 for the purpose of operating car lines in Macon and for building electric and power plants. The incorporators are W. J. Massee, J. T. Nyham, T. D. Massee, J. L. Anderson, O. J. Massee, Jr., and others.

DALLAS, TEX.—It is authoritatively announced that the Union Terminal Company, composed of all the railroads that enter Dallas, will not only erect a $5,000,000 union passenger station but will also install large shops, round house, electric power and light plant and extensive terminal facilities. F. G. Pettibone is president of the company, Thronwell Fay and W. A. Webb, vice-presidents; Murrell L. Buckner, treasurer; R. P. Roach, W. C. Conner, J. W. Robbins, C. W. Jones, J. W. Everman and F. G. Pettibone, members of the executive Committee.

## NEW INCORPORATIONS.

ALICE, TEX.—The Alice Ice & Light Company has been incorporated with a capital stock of $12,000 by George T. Rea, C. H. McShan and E. J. Stevens.

HUGO, OKLA.—Bomford Electric Company has been incorporated with a capital of $3,000, by Wright Bomford, Earl Shaffer and John D. Bomford, all of Hugo.

NEW YORK, N. Y.—The Leith Lighting Company has been incorporated with a capital stock of $600,000 and intends to deal in all inventions pertaining to gas and electricity.

AUGUSTA, ME.—The Rogers Electric Laboratories Company has been incorporated with a capital stock of $100,000 for the purpose of manufacturing and selling electric motors, dynamos and electrical machinery. E. M. Leavitt, Winthrop, is president and treasurer.

## PROPOSALS.

ELECTRIC PUSH-BUTTON LIFT.—Sealed proposals, in triplicate, will be received at the office of the Commissioner, by the Department of Commerce and Labor, Immigration Service, Port of Philadelphia, Gloucester City, N. J., until July 10 for furnishing all material and labor and installing an electric push-button lift in the detention building at this station, in accordance with the specifications, copy of which may be obtained from the Commissioner.

ELECTRIC CONDUITS AND WIRING AND INTERIOR LIGHTING FIXTURES.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until July 22 for electric conduits and wiring and interior lighting fixtures of a one-story building for the post office at Hanover, Pa.; until August 2 for the conduits, wiring and fixtures of the extension of the court house at Charlotte, N. C.; until August 5 for the conduits, wiring and fixtures for the post office at Marshall, Mo. Drawings and specifications may be obtained from the custodian of the various sites or from the office of the Supervising Architect.

## NEW PUBLICATIONS.

INTERNAL-COMBUSTION ENGINES.—In answer to a constantly increasing demand for information concerning the internal-combustion engine and the gas producer, the United States Bureau of Mines has issued Technical Paper No. 9, "The Status of the Gas Producer and of the Internal-Combustion Engine in the Utilization of Fuels." Robert H. Fernald, the consulting engineer of the Bureau on gas-producer practice, is the author of the paper. The tests have been made with carefully selected representative samples and carload lots of coal, lignite, etc., procured especially for the purpose by experienced collectors. The tests in the gas producer have shown that many fuels of so low grade as to be practically valueless for steaming purposes, such as slack coal, bone coal, and lignite, may be economically converted into producer gas and may thus generate sufficient power to render them of high commercial value. It is estimated that on an average each coal tested in the producer-gas plant developed two and one-half times the power that it would develop in the ordinary steam-boiler plant. Copies may be obtained by addressing the Director of the Buraeu of Mines, Washington.

## FINANCIAL NOTES.

Fundamentals continue to make a good showing, and it is believed that in financial centers at least the worst that can happen in politics has been amply discounted. The electrical business, as a whole shows improvement, several of the larger companies reporting a considerable increase in orders booked.

The sale of the Fremont Yaryan Company holdings to the American Gas & Electric Company, of New York city, has been consummated. New officers have been elected as follows: President, R. E. Breed, New York, president of the American Gas & Electric Company, vice-president, George W. Tidd, of New York; secretary and treasurer, Frank B. Ball, of Fremont. B. J. Shockley will continue as head of the Heating Department of the new concern and W. S. Smith as head of the electrical department. The concern will continue to be operated under the name of the Fremont Yaryan Company.

Commonwealth Edison Company business for the first half of calendar and fiscal year showed normal increases.

A special meeting of stockholders of the Washington (D. C.) Railway & Electric Company has been called for August 15 to vote upon a proposition to consolidate with that company the Anacostia & Potomac River Railroad Company, the Brightwood Railway Company and the Washington Woodside Forest Glen Railway & Power Company. The Washington Railway & Electric owns $1,993,250 of the $2,000,000 stock of the Anacostia & Potomac, $108,250 of the $108,500 stock of the Brightwood Railway and all of the capital stock of the Washington, Woodside & Forest Glen. The Washington Railway & Electric operates 160 miles of street railway in Washington. It has $6,500,000 common and $8,500,000 six per cent preferred stock. Its funded debt is $13,093,350. The company in 1911 paid two per cent on its common stock.

The Westinghouse Electric & Manufacturing Company, the Equitable Trust Company, Stone & Webster and William

Morris Imbrie & Company have formed a syndicate that has taken over the Electric Properties Company as a medium for dealing in public service corporation securities. The Electric Properties Company owns the entire stock of the Westinghouse, Church, Kerr & Company. The acquisition of the Electric Properties Company is to carry out the plans of Guy E. Tripp, chairman of the Westinghouse Electric & Manufacturing Company board, for the organization of a subsidiary corporation along the same lines as the Electric Bond & Share Company of the General Electric. The Electric Properties Company will finance and deal in the securities of public utility corporations. The Electric Properties Company has $6,000,000 common stock and $6,000,000 six-per-cent preferred stock; of the latter $4,000,000 is outstanding. Control of the Electric Properties Company has been vested in the Westinghouse Machine Company through the ownership of $5,000,000 of the $6,000,000 of common stock outstanding. This stock has been acquired by the Westinghouse Electric & Manufacturing Company and syndicate members associated with it.

### Dividends.

Associated Gas & Electric Company; a quarterly preferred dividend of 1.5 per cent, payable July 15 to stock of record June 29.

Augusta-Aiken Railway & Electric Corporation; a quarterly dividend of 1.5 per cent on the preferred stock, payable June 29.

Bay State Street Railway Company; a semiannual dividend of three per cent, payable August 1 to stock of record July 13.

Bell Telephone Company of Pennsylvania; a quarterly dividend of 1.5 per cent, payable July 15 to stock of record July 5.

Central & South American Telegraph Company; the regular quarterly dividend of 1.5 per cent, payable July 9 to stock of record June 29.

Dayton Power & Light Company; a quarterly preferred dividend of 1.5 per cent, payable July 15 to stock of record June 29.

Eastern Texas Electric Company; an initial semiannual dividend of $3 per share on the preferred stock, payable July 1 to stock of record June 25.

Edison Company of Boston; a regular quarterly dividend of three per cent, payable August 1 to stock of record July 15.

El Paso Electric Company; a semiannual preferred dividend of $3 per share, payable July 8 to stock of record July 1.

Electric Utilities Corporation; the regular quarterly dividend of 1.25 per cent on the preferred stock, payable July 15 to stock of record June 29.

Mexican Telegraph Company; the regular quarterly dividend of 2.5 per cent, payable July 15 to stock of record June 29.

Ohio Traction Company; a quarterly dividend of one per cert, payable July 1 to stock of record June 26.

Pacific Telephone & Telegraph Company; the regular quarterly dividend of 1.5 per cent on the preferred stock, payable July 15 to stock of record June 30.

Public Service Company of Northern Illinois; a quarterly common dividend of one per cent, and a quarterly preferred dividend of 1.5 per cent, both payable August 1 to stock of record July 24.

Puget Sound Traction, Light & Power Company; a quarterly dividend of $1 per share on the common stock, and $1.50 per share on the preferred, both payable July 15 to stock of record July 5.

Southern California Edison Company; a quarterly preferred dividend of 1.25 per cent, payable July 15 to stock of record June 29.

Southern New England Telephone Company; a quarterly dividend of 1.75 per cent, payable July 15 to stock of record June 29.

West Penn Traction Company; the regular quarterly dividend of 1.5 per cent on preferred stock, payable July 16 to stock of record July 6.

Wheeling Traction Company; a quarterly dividend of 1.25 per cent, payable July 15 to stock of record July 1.

### Reports of Earnings.

#### UNION ELECTRIC LIGHT & POWER.

The Union Electric Light & Power Company reports to the New York Stock Exchange for the year ended April 30, 1912, as follows:

| | |
|---|---|
| Commercial Lighting & Power income | $3,019,437 |
| Miscellaneous income (Municipal lighting, high tension, &c.) | 614,294 |
| Gross income | 3,633,731 |
| Operating expenses, taxes & reserves | 1,930,786 |
| Net income | 1,702,945 |
| Interest | 855,744 |
| Net earnings applicable for dividends | 847,201 |

#### AURORA, ELGIN & CHICAGO.

The Aurora, Elgin & Chicago Railroad reports as follows for May and eleven months ended May 31:

| | 1912 | 1911 |
|---|---|---|
| May gross | $ 159,262 | $ 152,751 |
| May net | 65,004 | 62,816 |
| Interest and taxes | 35,931 | 35,842 |
| Surplus | 29,073 | 26,973 |
| Eleven months gross | 1,664,061 | 1,574,293 |
| Eleven months net | 720,980 | 662,171 |
| Interest and taxes | 403,238 | 380,107 |
| Surplus | 317,742 | 282,064 |

#### CENTRAL & SOUTH AMERICAN TELEGRAPH.

The Central & South American Telegraph Company reports for the quarter ended June 30, 1912 (partly estimated), compared as follows:

| | 1912 | 1911 |
|---|---|---|
| Gross | $ 384,000 | $ 395,000 |
| Net | 232,500 | 233,000 |
| Total income | 235,750 | 233,750 |
| Dividends | 143,565 | 143,565 |
| Surplus | 92,185 | 90,185 |
| Previous surplus | 2,794,323 | 2,347,257 |
| Total surplus | 2,886,508 | 2,437,442 |

#### MEXICAN TELEGRAPH.

The Mexican Telegraph Company reports for the quarter ended June 30, 1912 (partly estimated), compared as follows:

| | 1912 | 1911 |
|---|---|---|
| Gross | $ 215,000 | $ 210,000 |
| Net | 169,500 | 169,000 |
| Total income | 192,849 | 186,126 |
| Dividends | 89,735 | 89,735 |
| Surplus | 103,114 | 95,391 |
| Previous surplus | 3,054,973 | 2,673,741 |
| Total surplus | 3,158,087 | 2,769,132 |

#### DIRECT U. S. CABLE COMPANY.

The report of the directors of the Direct United States Cable Company is for the nine months ended March 31, 1912, at which date it has been decided to close the company's financial year, to coincide with the lease of the cables to the Western Union Telegraph Company, which has been duly completed, and is for ninety-nine years from April 1, 1911. After payment of a dividend at the rate of four per cent per annum and a bonus at the rate of one per cent per annum for the nine months to March 31, 1912, a surplus of revenue remains of £7,399, which has been credited to the reserve fund account. The reserve fund account shows a balance of £509,128, as compared with £512,323 at June 30, 1911, a decrease of £3,194, which is accounted for by expenses in connection with the lease above referred to.

#### MARCONI WIRELESS TELEGRAPH.

The Marconi Wireless Telegraph Company, Ltd. (London) reports for the year ended December 31, 1911, as follows:

| | |
|---|---|
| Net profits | £141,717 |
| Dividends | 46,679 |
| Surplus | 95,038 |
| Previous surplus | 65,719 |
| Profit and loss surplus | 160,757 |

#### UNITED TRACTION COMPANY.

The United Traction Company reports to the New York Up State Public Service Commission for the quarter ended March 31, 1912, compared as follows:

| | 1912 | 1911 |
|---|---|---|
| Gross | $560,584 | $537,234 |
| Net after taxes | 111,733 | 136,713 |
| Other income | 54,474 | 50,952 |
| Total income | 166,208 | 187,665 |
| Surplus after charges | 58,095 | 84,805 |

#### INTERNATIONAL RAILWAY COMPANY.

The International Railway Company reports to the New York Up State Public Service Commission, for the quarter ended March 31, 1912, compared as follows:

| | 1912 | 1911 |
|---|---|---|
| Gross | $1,188,304 | $1,138,194 |
| Net after taxes | 340,538 | 344,273 |
| Other income | 16,247 | 3,230 |
| Total income | 356,785 | 347,504 |
| Surplus after charges | 143,587 | 139,398 |

#### NEW YORK RAILWAYS COMPANY.

The New York Railways Company reports for April and four months as follows:

| | April, 1912 | Jan. 1-Apr. 30 |
|---|---|---|
| Gross | $1,157,654 | $4,397,516 |
| Net after taxes | 389,475 | 1,279,598 |
| Other income | 32,649 | 127,296 |
| Total income | 422,124 | 1,406,894 |
| Deduct. includ. int. on underlying bonds | 219,314 | 865,626 |
| Interest on refunding 4s | 55,893 | 222,572 |
| Balance | 146,916 | 317,694 |

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

| | July 1. | June 24. |
|---|---|---|
| Allis-Chalmers common (New York) | 1⅜ | ¾ |
| Allis-Chalmers preferred (New York) | 4½ | 1⅞ |
| American Tel. & Tel. (New York) | 144⅞ | 146 |
| Commonwealth Edison (Chicago) | 139 | 139¼ |
| Edison Electric Illuminating (Boston) | 291 | 286 |
| Electric Company of America (Philadelphia) | •12¼ | •12¼ |
| Electric Storage Battery common (Philadelphia) | 55½ | 55½ |
| Electric Storage Battery preferred (Philadelphia) | 55½ | 55½ |
| General Electric (New York) | 177 | 172 |
| Kings County Electric (New York) | 129 | 129 |
| Manhattan Transit (New York) | 2 | 2 |
| Massachusetts Electric common (Boston) | 19½ | 19¾ |
| Massachusetts Electric preferred (Boston) | •92 | •92 |
| National Carbon common (Chicago) | 113 | 115 |
| National Carbon preferred (Chicago) | 118 | 117 |
| New England Telephone (Boston) | 153 | 152½ |
| Philadelphia Electric (Philadelphia) | 22½ | 22 |
| Postal Telegraph and Cables common (New York) | 88⅝ | 87½ |
| Postal Telegraph and Cables preferred (New York) | 68½ | 69 |
| Western Union (New York) | 82¾ | 82 |
| Westinghouse common (New York) | 76 | 72¼ |
| Westinghouse preferred (New York) | 118 | •118 |

•Last price quoted.

## PERSONAL MENTION.

J. M. BRYANT, professor in the Electrical Engineering Department, University of Illinois, will become electrical engineer for the Kankakee & Urban Traction Company.

JOHN MALM will soon take up the duties of city electrician in Denver, Colo., Messrs. C. B. Thorn and B. Oliver will be associated with Mr. Malm in the Electrical Inspection Department.

EDGAR D. SIBLEY has severed his connections as assistant to the superintendent of power of the Brooklyn Rapid Transit Company to engage in electrical engineering work with Walter G. Clark, of New York City.

H. G. WILSON, who has for several years been electrical inspector of the Chicago Board of Underwriters, has resigned his position to accept a place as electrical engineer for the Fred S. James Fire Insurance Company, Chicago.

GEORGE F. BROCKMAN has been appointed manager for the Public Service Corporation of Northern Illinois at Minonk, Rutland and Toluca. Mr. Brockman was formerly superintendent of the Union Light & Power Company, Minonk, Ill.

ARTHUR H. BERNDT, Indianapolis, Ind., has been appointed assistant manager of the Indianapolis branch of the Remey Electric Company. Mr. Berndt is a graduate of the Indianapolis Training School and also of the Indiana University.

ALEXANDER J. KLEIN, the youngest son of J. M. Klein, manager of the well known firm of Mathias Klein & Sons, Chicago, was married June 19 to Miss Kathleen Brennan, of Chicago. The newly married couple will make their home in Rogers Park, Chicago.

KENNETH WINDHAM ENDRES, lately associated with the Western Electric Company, at New York, as a railway sales engineer, has resigned from that company to become assistant treasurer of the Windram Manufacturing Company, 40 Oliver Street, Boston, Mass.

CHARLES F. SCOTT, professor in the Department of Electrical Engineering of Yale University, has had the honorary degree of Doctor of Engineering conferred upon him by the Stevens Institute of Technology. Professor Scott is a past-president of the American Institute of Electrical Engineers.

B. M. DOWNS, of the Hemingray Glass Company, Covington, Ky., has been ill in Cincinnati for the past three weeks, narrowly escaping a serious surgical operation. His condition for a time was quite serious and a rest will be necessary, so he expects to return to New York soon to recuperate.

C. E. CLEWELL, illuminating engineer with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., will this fall become associated with the Department of Electrical Engineering of the Sheffield Scientic School of Yale University. Mr. Clewell has at different times prepared papers on illuminating engineering subjects for the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and other engineering societies, and has also contributed liberally to the technical press.

WILLIAM VON PHUL has been admitted into partnership in the firm of Ford, Bacon & Davis, New York. He graduated from Tulane University in 1891 as mechanical engineer. During the next ten years he was general superintendent of the Louisiana Electric Light Company and of the Edison Electric Company of New Orleans and also of the New Orleans & Carrollton Railroad, Light & Power Company. He then took charge of the operation of the Cincinnati Gas & Electric Company as general superintendent, and since 1905 has been connected with the engineering and operating forces of Ford, Bacon & Davis at New Orleans, being also vice-president of the American Cities Company.

HENRY S. CARHART, emeritus professor of physics and electrical engineering at the University of Michigan, was a visitor to Chicago during the past week. At the Commencement of Northwestern University on June 12, the university conferred on Dr. Carhart the honorary degree of Doctor of Science. On June 27, the University of Michigan conferred on Dr. Carhart the honorary degree of Doctor of Laws. This is a well merited recognition of a great deal of very superior work, and we unite with a host of friends of Dr. Carhart in congratulating him upon the award of these degrees and commending these institutions for their good judgment in conferring this distinction. Dr. Carhart, while retired from active service, is still busy with many problems in physics and electrical engineering, and is living at the present time in Pasadena, Cal.

CHARLES F. UEBELACKER, who has just become a partner in the firm of Ford, Bacon & Davis, New York, graduated from Princeton University, in 1889 as an electrical engineer. For the next few years he was employed by various manufacturing and electrical concerns, having been chief engineer of the short Electric Railway Company and the Brush Manufacturing Company, of Cleveland, electrical engineer of the Consolidated Traction Company, New Jersey, and later chief engineer and manager of the Peckham Truck Company, Kingston, N. Y. In 1899 he became connected with the firm of Ford, Bacon & Davis having in charge for them the operation of the Elmira Water, Light & Railroad Company, as vice-president and general manager. In 1901 he joined the organization of the firm in New York and since 1902 has been its chief engineer.

CHARLES N. BLACK, a graduate of Princeton University as electrical engineer in 1890, has been admitted into partnership in the firm of Ford, Bacon & Davis, New York. From his graduation until 1899 he was in the employ of electrical manufacturing companies in the design and construction of electric railway and electric lighting machinery, having been superintendent of the shops of the Brush Manufacturing Company, Cleveland, and manager of the New Haven factory of the Westinghouse Electric & Manufacturing Company. In 1899 he became connected with the engineering organization of Ford, Bacon & Davis and until 1902 was its chief engineer. After the firm finished its work of re-constructing the Kansas City cable system into an electric railway system, of which Mr. Black was in charge, he became vice-president and general manager of the Kansas City Railway & Light Company, continuing until 1907 when he assumed his present position of vice-president and general manager of the United Railroads of San Francisco.

WILLIAM E. BARROWS, JR., has been appointed professor of electrical engineering at the University of Maine, Orono, Me. Professor Barrows was graduated from this university in 1902 and received from it the degree E. E. in 1908. He spent two years at the Lynn works of the General Electric Company and then served two years as instructor in the electrical faculty of the University of Pennsylvania. Since 1906 he has been instructor and assistant professor of electrical engineering at Armour Institute of Technology, Chicago. Professor Barrows has devoted himself largely in recent years to illuminating engineering; he has frequently contributed to the technical press on this and other subjects and is the author of two books, "Electrical Illuminating Engineering," written in 1908, and "Light, Photometry and Illumination," which is now in press. He was one of the Johns Hopkins lecturers in the special course on illuminating engineering given in the fall of 1910 and contributed the chapter on "Illumination Calculations" in the published lectures. Among the various engineering societies of which he is a member, he has been particularly prominent in the Illuminating Engineering Society, of whose Chicago Section he was recently elected chairman. The many Chicago friends he has made in the last six years wish him success in his new work, which will bring him near to his old home at Augusta, Me.

## OBITUARY.

WILLIAM NORTHROP, president of the Virginia Railway & Power Company, Richmond, Va., died suddenly at his home near Forest Hill on June 11, at the age of 43. Mr. Northrop was educated in Philadelphia, Pa., and at the University of New York. After graduation he first became associated with the Philadelphia & Reading Railroad and in 1897 he led an expedition into the interior of Alaska. In 1902 he was appointed assistant secretary and assistant treasurer of the consolidated properties of the Richmond Passenger & Power Company and the Richmond Traction Company, and in 1909 when the Virginia Railway & Power Company was organized as successor to this consolidation, Mr. Northrup was elected president of the company. He was also, at the time of his death, president of the Norfolk Railway & Light Company and the City Gas Company of Norfolk; vice-president of the Richmond & Chesapeake Bay Railroad Company and president of the Fredericksburg Electric Company, a member of the Chamber of Commerce of Richmond and a director of the National Bank of Virginia. Mr. Northrop is survived by a widow.

ANDREW E. STEVENS, manager of the Consumers Power Company, Minot, N. D., met death Saturday, June 22, in an automobile accident in which his wife was also severely injured. Three other ladies were in the party, which was returning from a short early-morning trip in the country. Five miles south of the city, as the car was going down a steep hill, it ran off an

embankment, overturning and pinning Mr. and Mrs. Stevens beneath. Mr. Stevens died within three hours after reaching the hospital. Two of the other ladies were severely injured. One of these was Miss Hazel Thompson, employed as stenographer by the company. Mr. Stevens was born in Rushford, Minn., February 7, 1869. He was educated in the public schools of Winona, Minn., and in the University of Minnesota. At an early age his father died, throwing upon him responsibility as the oldest son of the family. Mr. Stevens had been in the employ of H. M. Byllesby & Company since January, 1911. Previously he had experience in shop and street railway work in Minneapolis and St. Paul. He also had been manager of several telephone exchanges for the Wisconsin Telephone Company, and had served on the sales force of the Fort Wayne Electric Works, Chicago office. Mr. Stevens was a member of the Beta Theta Pi Fraternity. In Minot he was an active member of the Commercial, Elks and Minot Gun Clubs. He was married to Miss Emma Howard and is survived by her and one son, fourteen years old.

The funeral was held June 25, in Minneapolis.

### DATES AHEAD.

New England Electrical Workers' Association. Providence, R. I., July 13-14.

National Electrical Contractors' Association. Annual meeting, Denver, Colo., July 16-19.

Ohio Electric Light Association. Annual convention, The Breakers, Cedar Point, O., July 16-19.

International Association of Municipal Electricians. Annual convention, Peoria, Ill., August 26-30.

International Association for Testing Materials. Sixth congress, New York City, September 3-7.

Illuminating Engineering Society. Annual convention, Hotel Clifton, Niagara Falls, Ont., September 16-19.

Association of Iron and Steel Electrical Engineers. Annual convention, Hotel Pfister, Milwaukee, Wis., September 16-21.

The 1912 Boston Electric Show. Mechanics Building, Boston, Mass., September 28-October 26.

American Electric Railway Association and its five affiliated associations. Annual convention, Chicago, Ill., October 7-11.

New England Section of the National Electric Light Association. Fall meeting, Boston, Mass., October 10-11.

The New York Electrical Exposition and Automobile Show. The New Grand Central Palace, New York City, October 9-12.

Kansas Gas, Water, Electric Light and Street Railway Association. Annual meeting, Manhattan, Kans., October 17-19.

# With the Electrical Manufacturers

**The J. M. Carpenter Tap & Die Company,** Pawtucket, R. I., has issued several price lists of its small round die sets, screw plate die sets, full mounted die sets and adjustable die stock sets.

**The Cruse-Kemper Company.** Ambler, Pa., one of the largest manufacturers of gas holders, will make extensive improvements to its power house and shops. Hackett & Mora, Drexel Building, Philadelphia, are the consulting engineers.

**Allis-Chalmers Company,** Milwaukee, Wis., has issued bulletin No. 1626, which is devoted to hydraulic turbines of the single vertical open-flume type with gearing and harness work as are commonly used in multiple to drive a horizontal shaft in flour mills and occasionally in hydroelectric plants.

**Mathias Klein & Sons,** 562 West Van Buren street, Chicago, have issued a new pocket tool guide which will be found of value by wiremen, linemen and electricians in general. This is a handy 64-page catalog of the great variety of electrical tools made by this well known firm. A 24-page net-price and discount sheet applying to catalog No. 10 has also just been issued.

**Pittsburgh Electric Furnace Company,** Pittsburgh, Pa., builder of electric furnaces for the smelting of steel, iron, copper, zinc and other metals, has received orders for the installation of several furnaces with capacity for melting 1,000 pounds per hour. The orders received include sales to the following companies: United States Reduction Company, Pittsburgh, aluminum; Great Western Refining & Sintering Company, St. Louis, brass turnings; P. Healy, Evansville, Ind., tilting furnace for brass; Electric Railway & Improvement Company, Chicago, copper.

**Westinghouse Electric & Manufacturing Company,** East Pittsburgh, Pa., announces that among many orders received by its railway department the following are particularly notable. An order from a traction company in New York City for 100 double-motor equipments and controllers; City Railway Company, Los Angeles, Cal., 54 double equipments and control sets; one of the large traction companies of Chicago, 125 double equipments and control sets.

**The Ridgway Dynamo & Engine Company,** Ridgway, Pa., has issued bulletins 25 and 26, devoted to direct-current generators and motor-generator sets, respectively. The dynamos are of the engine and belted types and are made in standard voltages and ratings, also for three-wire service. The motor-generator sets are made in two or three-unit groups, comprising direct-current or alternating-current machines or both; they are used for current conversion or transformation, frequency changing, balancing, boosting, etc. Each bulletin describes and illustrates the machines fully.

**Ford, Bacon & Davis,** New York, N. Y., announce that Charles F. Uebelacker, Charles N. Black and William Von Phul have been admitted to partnership. To the engineering profession these men are well known through their records of the past twenty years. The policy of the firm will continue as in the past, in the efforts to improve the standards of construction and to increase the efficiency of the operation of the properties entrusted to its charge, through the personal attention of its partners. The firm of Ford, Bacon & Davis was established in 1894, and has in its service an experienced organization. With the new partners it is in a position to materially extend its present engineering and management facilities for investigations and reports, and for the design, construction and operation of public utility and engineering enterprises generally. The principal branch offices of the firm at 921 Canal Street, New Orleans, and 85 Second Street, San Francisco, will each be in charge of a resident partner.

**The General Electric Company,** Schenectady, announces that the Wolverine Brass Works, Grand Rapids, Mich., is installing new General Electric electrical apparatus recently purchased consisting of a 312-kilowatt engine-type generator and a 14-kilowatt exciter. The Osborne Twine Mills, Auburn, N. Y., will soon install new equipment for electric motor drive comprising nineteen induction motors ranging from 5 to 50 horsepower, three 333 kilvolt ampere and two 20-kilovolt-ampere transformers, two regulators and switchboards. All this apparatus will be furnished by the General Electric Company. The Union Stock Yards Company, Omaha, Neb., will soon add to its power equipment two 150-horsepower motors recently ordered from the General Electric Company. The Mount Whitney Power & Electric Company, Visalia, Cal., will install in its station a new 937-kilowatt turbogenerator, 25-kilowatt exciter set and switchboard, which were recently ordered from the General Electric Company. The Eastern Michigan Power Company, Jackson, Mich., has recently ordered from the General Electric Company additional aparatus for its power station consisting of one 250-kilowatt, 7,200-720-volt and one 43-kilowatt, 5,000-2,500 to 500-250-volt regulators and ten oil switches and panels. The Great Western Power Company, San Francisco, Cal., has ordered from the General Electric Company three 750-kilowatt 22,000-2,400-volt transformers for a substation at Sacramento. The Yuba Construction Company, San Francisco, Cal., has recently ordered from the General Electric Company for installation on a big

river dredge at Sumpter, Ore., one 200-horsepower motor, six smaller induction motors, ranging from two to 75 horsepower and switchboard.

**The Western Electric Company** recently opened a large warehouse and branch office at Houston, Texas, in order to handle more effectively the growing business in the Gulf Coast district. This move of the company is a recognition of Houston's superior position as a shipping point and a center for buyers of electrical goods. The new house is operated as a branch of the Dallas organization under the supervision of R. W. Van Valkenburgh and Paul Joyslin, manager and sales manager, respectively. The local organization has as its resident heads: H. P. Hess, in charge of sales; F. G. Caldwell, in charge of store, and M. A. Schon, in charge of warehousing. Complete stocks of telephone, power, supply and line material are carried.

# Record of Electrical Patents.

## Issued by the United States Patent Office, June 25, 1912.

**1,030,288. Ignition System for Gas Engines.** W. E. Dow, Braintree, Mass. Includes a magneto, battery, induction coil, spark plugs and a special assembly of contacts for connecting them.

**1,030,297. Apparatus for Igniting Miners' Lamps.** E. A. Hailwood, Morley, near Leeds, Eng. An electromagnet co-operates with a friction igniter in a casing into which the lamp is placed.

**1,030,302. Gas or Vapor Electric Lamp.** P. C. Hewitt, assignor to Cooper Hewitt Electric Co., New York, N. Y. An inverted U-shaped mercury-vapor tube with a starting shunt around part thereof.

**1,030,304. Registering Apparatus.** H. Hollerith, Garrett Park, Md., assignor to Tabulating Machine Co. Is electromagnetically controlled.

**1,030,305. Apparatus for Use in Tabulating Systems.** H. Hollerith, Garrett Park, Md., assignor to Tabulating Machine Co. Includes a set of electromagnets and relays for controlling the tabulating machine.

**1,030,307. Train-Signaling Mechanism.** H. Jarvis, Buffalo, N. Y., and L. R. Jarvis, Toronto, Ont. Adjoining the track is a grid adapted to close a signal circuit on the occurrence of a landslide or avalanche.

**1,030,308. Telephone Installation.** H. O. Kabitzsch, assignor to Firm of Gustav A. Meyer-Henniger, Hamburg, Germany. Includes visible signals at each substation notifying the party that the number called can or cannot be obtained.

**1,030,319. Sostenuto Attachment for Electropneumatic Instruments.** L. E. Morel, St. Hyacinthe, Quebec, Can. Includes electromagnets for controlling the series of bellows.

**1,030,339. Sign.** C. W. Smith, assignor to Thomas Cusack Co., Jersey City, N. J. Incandescent lamps are placed in a hood, whose short translucent front acts as an internal reflector to throw part of the light on the lower rear wall.

**1,030,345. Lamp Socket and Shade-Holder.** M. P. Stevens, East Orange, N. J. Has a ring with cams which on rotation compress the spring fingers that hold the shade.

**1,030,349 and 1,030,350. Metallurgy of Zinc.** C. V. Thierry, Paris, France. An electric-furnace process in which oxide of zinc and carbon are progressively charged.

**1,030,354. Means for Supporting and Driving Electric Generators.** G. M. Turner, assignor to Holm's Machine Manufacturing Co., Sparta, Mich. One end of the magneto armature is connected to the engine shaft and the field and housing are supported from the armature bearings.

**1,030,355. Street Indicator.** C. H. Vickery, Attica, N. Y., assignor of one-fourth to J. M. Slater and one-fourth to L. M. Slater. A helically moving drum is rotated by an electromagnet.

**1,030,368. Secondary Electric Clock.** T. H. Wurmb and R. Baumann, assignors to National Clock & Electric Manufacturing Co., St. Louis, Mo. Includes an electromagnetically actuated pawl.

**1,030,369. Invisible Lighting Unit.** L. W. Young, New York, N. Y. The lamps are concealed in a ring-shaped trough above which is a translucent reflector.

**1,030,370. Holder for Shades or Globes.** L. W. Young, New York, N. Y. An annular shade-supporting member is divided into sections having tongues that fit in grooves in a collar surrounding them.

**1,030,371. Dust-Collector for Lamp Globes.** L. W. Young, New York, N. Y. A plate surrounds the socket and fits close to the inside of the globe.

**1,030,412. Impulse Transmitter.** J. W. Lattig, assignor to American Automatic Telephone Co., Rochester, N. Y. A revolving contact-making and breaking controller.

**1,030,413. Electric Ignition Device.** J. J. Lombardi, New York, N. Y. A spark plug with a hollow base.

**1,030,415. Relay and Circuits Therefor.** R. H. Manson, assignor to Dean Electric Co., Elyria, O. A magneto telephone drop relay.

**1,030,422. Apparatus for Inspecting Bottles.** H. G. Muench, San Francisco, Cal. Tubular incandescent lamps are raised into the mouths of the inverted bottles.

**1,030,432. Electric Igniter.** F. H. Royce, Derby, England. Includes a rotating and several fixed electrodes for the distributer.

**1,030,435. Electrical Starting Device.** J. L. Schureman, assignor to J. L. Schureman Co., Chicago, Ill. An electromagnetic toggle mechanism for closing a pivoted circuit-breaker.

**1,030,436. Railway Signaling System.** L. H. Thullen, assignor to Union Switch & Signal Co., Swissvale, Pa. A block signal system for a single-phase railway.

**1.030,441. Contact-Maker.** J. F. Webb, Jr., assignor to Electric Signagraph & Semaphore Co., New York, N. Y. Has a pair of contact wheels upon which bear spring collectors.

**1,030,443. Automatic Sprinkler and Alarm.** T. Williams and A. Lewis, San Francisco, Cal. The sprinkler heads are held in place by fusible conductors in a thermostatic electric circuit.

**1,030,490. Apparatus for the Recovery of Precious Metals.** H. N. Potter, Hollywood, Cal. An electrolytic apparatus for treating gold amalgam.

**1,030,504. Telephony.** E. R. Corwin, assignor to Corwin Telephone Manufacturing Co., Chicago, Ill. An intercommunicating private telephone system.

**1,030,505. Telephone System.** E. R. Corwin, assignor to Corwin Telephone Manufacturing Co. An intercommunicating system with a special "busy" test.

**1,030,509. Telegraphing Instrument.** C. C. Ferguson, New York, N. Y. A typewriter-transmitter.

**1,030,516. Illuminated Vest or Coat Buttons.** E. S. Lagarde and P. A. Angenend, Jr., Houston, Tex. Miniature lamps are controlled from a pocket battery.

**1,030,543. Syringe with Electric Attachment.** L. R. Saunders, Los Angeles, Cal. One electrode is in the path of the inflowing liquid, the other is applied externally to the patient's body.

**1,030,548. Motor-Control System.** H. A. Steen, assignor to Allis-Chalmers Co., Milwaukee, Wis. Relays govern the switches that successively cut out resistance.

**1,030,550. Telephone Instrument.** W. P. Stunz, assignor to G. R. Webb, Baltimore, Md. Includes a diaphragm free at its periphery that is constantly held in operative position by a magnet.

**1,030,551. Telephonic Instrument, including Transmitters.** W. P. Stunz, assignor to G. R. Webb, Baltimore, Md. About the granular carbon is a cooling chamber.

**1,030,555. Thermostatic Time-Element Device.** N. Wilkinson, assignor to Allis-Chalmers Co. A heating coil is adapted to trip a circuit-breaker clutch.

**1,030,556. Dynamo-Electric Machine.** R. B. Williamson, assignor to Allis-Chalmers Co. Self-ventilating fans and ducts are provided.

**1,030,557. Dynamo-Electric Machine.** R. B. Williamson, assignor to Allis-Chalmers Co. Includes two parallel connected windings producing different phases with a transformer between them to prevent local current.

**1,030,568. Circuit-Breaker.** H. W. Cheney, assignor to Allis-Chalmers Co. Relates to the releasing mechanism.

**1,030,569. Controller.** H. W. Cheney, assignor to Allis-Chalmers Co. A drum-

type controller biased back from the starting positions and forward from the running position.

**1,030,571. Brush-holder.** C. T. Crocker, assignor to Allis-Chalmers Co. and Bullock Electric Manufacturing Co. Relates to the pressure-applying device.

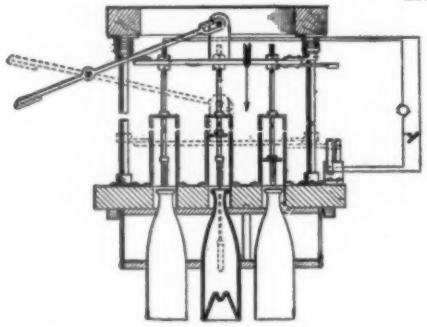
**1,030,574. Insulator-Supporting Device.** C. G. Ette, assignor to Ette Investment Co., St. Louis, Mo. Two metal insulator pins are secured to a single support fastened to the cross-arm so that the insulators are out of alinement and one is above and the other below the arm.

**1,030,581. Dynamo-Electric Machine.** A. M. Gray, assignor to Allis-Chalmers Co. A synchronous machine with grouped short-circuiting rods in the field.

**1,030,583. Self-Starter for Automobiles.** F. G. S. Hewitt, Detroit, Mich. A special arrangement of the ignition circuit to permit noting when cylinder is in favorable starting condition.

**1,030,493. Switch.** A. J. Loguin, assignor to Allis-Chalmers Co. Relates to details of a circuit-breaker.

**1,030,595. Turbo Construction.** E. Mattman, assignor to Allis-Chalmers Co. A special collector construction for a turbogenerator.



1,030,422.—Electric Bottle Inspector.

**1,030,597. Trolley Wheel.** J. S. McCabe, assignor to Montclair Manufacturing & Machine Co., Bridgeville, Pa. A special flanged-hub construction.

**1,030,617. Electric Controller.** R. V. R. Sill, assignor of two-thirds to A. E. Pelham, New York, N. Y. A pilot motor controlled by the master switch actuates the power controller.

**1,030,620. Method of Treating Carbon Articles of Low Initial Conductivity.** E. C. Sprague and A. M. Williamson, assignors to International Acheson Graphite Co., Niagara Falls, N. Y. The articles are placed in a resistance furnace and current sent through them in series with intervening resistance material.

**1,030,622. Circuit-Controller.** T. G. Stiles, Arlington, N. J. Includes a sliding contact rod and a number of contact fingers engaging it and a tubular socket.

**1,030,641. Apparatus for Soldering Metal Pieces.** A. R. Braden, assignor to United Shoe Machinery Co., Paterson, N. J. Includes a master plate, an electric heater therefor, and means for magnetizing the plate.

**1,030,642. Electric-Light Arm.** S. D. R. Braun, Chicago, Ill. A conduit pipe has a socket secured to its end about which there is a socket cover.

**1,030,645. Motor-Control System.** H. W. Cheney, assignor to Allis-Chalmers Co. The motors may be connected through relay switches with a constant or a variable-potential source.

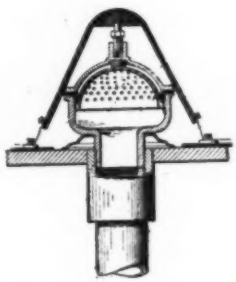
**1,030,650. Electric Battery.** H. De Martis, London, Eng. The separators between the storage-battery plates are composed of a porous, woven, cellulose fabric.

**1,030,666. Process of Manufacturing Incandescent-Lamp Filaments.** H. Kuzel, assignor to General Electric Co. Colloidal material is mixed with a fine metallic powder, worked into a plastic mass, shaped into a filament, dried and heated in an inert atmosphere.

**1,030,670. Trolley-Wire-Cleaning Device.** N. Malmgren, L. N. Todd and S. J. Watson, Canton, Ill. Has special sleet-cutting wheels

**1,030,672. Electric Heating System for Boilers.** J. F. McElroy, Albany, N. Y., assignor to Consolidated Car Heating Co. The electric heaters are controlled by the water level and steam pressure.

**1,030,684. Telephone Stand.** H. W. Schussler, Philadelphia, Pa. Has an arm for holding the receiver to the ear.



1,030,443.—Sprinkler-Head Alarm.

**1,030,692. Apparatus for Sterilizing Liquids by Means of Ultra-Violet Rays.** P. G. Triquet, Paris, France. Includes a number of mercury-vapor lamps.

**1,030,780. Multiplex Telegraph System.** J. F. D. Hoge, assignor to American District Telegraph Co., New York, N. Y. Has alternating-current and direct-current signaling systems, the former including electrolytic rectifiers for neutral receiving relays

**1,030,788. Electric Switch.** H. J. Morey and F. A. Brogden, Syracuse, N. Y. A push-button rocking spring switch.

**1,030,791. Trolley Catcher.** J. R. Ricketts, Longbeach, Cal., assignor to Los Angeles Trolley Catcher Co., Los Angeles, Cal. A spring-actuated reel is controlled by a pair of dogs.

**1,030,798. Busbar-Connecting Device.** F. B. Adam, assignor to Frank Adam Electric Co., St. Louis, Mo. A special connector for joining busbars at right angles.

**1,030,811. Polarized Relay.** W. S. Henry, assignor to General Railway Signal Co., Gates, N. Y. Includes a U-shaped permanent magnet with two iron members attached to one limb.

**1,030,817. Binding-Post for Connecting Electric Cables.** G. Honold, assignor to Firm of Robert Bosch, Stuttgart, Germany. Has two right-angled bores into one of which the cable is fitted and distended.

**1,030,825. Combined Memorandum-Pad Support and Lighting Device.** O. Knoerzer and J. W. Weis, Hammond, Ind.; said Knoerzer, assignor to said Weis. Has a miniature lamp mounted on a battery case.

**1,030,850. Liquid Rheostat.** H. A. Steen, assignor to Allis-Chalmers Co. The walls of the receptacle form one electrode and adjustable plates in the interior the other.

### Reissue.

**13,432. Outlet Box for Electric Conduits.** W. A. Bonnell, assignor to H.W. Bonnell, Brooklyn, N. Y. Original No. 921,584, dated May 11, 1909. Has conduit bushings in its base and clamping wedges adjacent the bushings.

### Patents That Have Expired.

Following is a list of electrical patents (issued by the United States Patent Office) that expired July 2, 1912:

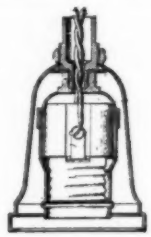
**541,854. Dynamo-Electric Machine.** T. H. Hicks, Detroit, Mich.

**541,919. Commutator-Brush.** H. B. Collins, Fulton, N. Y.

**541,921. Manufacture of Electrical Conductors.** L. W. Downes, Providence, R. I.

**541,929. Incandescent Electric Lamp.** R. Greer, Westbrook, Me.

**541,949. Block Signal for Railways.** W. G. Roome, Jersey City, N. J.



1,030,642.—Socket and Cover.

**541,967. Automatic Telegraphy.** P. B. Delany, South Orange, N. J.

**541,994. Duplex and Diplex Telegraphy.** M. M. Davis, Brooklyn, N. Y.

**341,998. Electric Wire Joint.** A Gartner, Newark, N. J.

**542,030. Automatic Safety Device for Electric Circuits.** L. G. Rowand, Camden, N. J.

**542,036. Electric Locomotive.** T. E. Adams, Cleveland, O.

**542,049. Galvanic Battery.** R. W. Gordon, Boston, Mass.

**542,066. Annunciator Circuit for Telephone Switchboards.** C. E. Scribner, Chicago, Ill.

**542,105. Conduit Electric Railway.** L. C. Pressley, San Francisco, Cal.

**542,108. Train Annunciator.** C. H. Rittenhouse, Kendallville, Ind.

**542,109. Coin-Operated Toll Collector and Annunciator.** W. A. Rogers, Omaha, Neb.

**542,142. Signaling.** D. L. V. Browne, Denver, Colo.

**542,164. Conduit Electric Railway.** L. R. Lavelle and A. H. Lavelle, Holyoke, Mass.

**542,191. Magneto-Electric Telephony.** E. S. Halsey, Evanston, Ill.

**542,210. Safety Device for Handling Electric Arc Lamps.** E. P. Snowden, St. Joseph, Mo.

**542,224. Matrix-Making and Printing-Bar Casting Machine.** H. Lee, New York, N. Y., and E. Lebrun, Newark, N. J.